The Dock and Harbour Authority

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Editorial Comments

Greenock Harbour Development.

Although, to some extent, overshadowed by the larger port of Glasgow, situated some 20 miles further inland on the banks of the Clyde, the Port of Greenock, lying seaward on the Firth of Clyde is an important focus of sea-borne trade and also a centre of the shipbuilding industry. Many notable vessels have been built at Greenock slips. At least as many have been engined and fitted out at Greenock workshops.

Like other ports in the kingdom, Greenock has been considering its post-war outlook and investigating the possibilities of future development. In this issue we are able, through the courtesy of the Port Authority, to publish a scheme prepared by their general manager and engineer, Mr. Donald Smith, for the remodelling and extension of the shipping accommodation at the port. It is a scheme of considerable magnitude, envisaging not merely the commercial aspect of the problem, but also making provision for the establishment of a naval base which will be commensurate with the growing demands in regard to national warship production.

There is no doubt that from the point of view of location, Greenock is admirably suited to these purposes, as well as for the exploitation of civil aviation. It lies in a sheltered position in an estuary which affords good anchorage and a deep water approach to the port, and there is also ample landing water available for aircraft. The details of the scheme, so far as they have been worked out, will be found in Mr. Smith's report.

The port has a history, records of which can be traced back to 1164, when it was known to possess a safe anchorage for shipping. Its commerce, however, was very moderate, if not insignificant, until the Treaty of Union, in 1707, between England and Scotland, when it received a considerable impetus in consequence of the development of trade with America and the West Indies. The first port works on a large scale were undertaken and completed in 1710; these, indeed, were the first of any consequence constructed in Scotland.

Considerable additions and extensions have been made since that date, and at the present time, there is enclosed, or partially enclosed, water area to the extent of forty-two acres or rather more, with quayage therein and on the Clyde aggregating nearly 20,000 lineal feet. The most important, in fact the only, dock, strictly speaking (the others are tidal harbours or basins) is the James Watt Dock of 14¼ acres, with an impounded depth of water of 28-ft. The name of this dock indicates the close association of Greenock with the renowned inventor who was born there.

Movable Bridges over Port Waterways.

In the waterfront district of a port characterised by numerous docks and basins ,and in port areas intersected by rivers and canals, there is an essential need for movable bridges to enable road and rail traffic to be carried on without inconvenient detours, and to link up the different sections of the harbour so as to facilitate communication. There are many ports in Great Britain and on the Continent where such conditions prevail; they are less frequent perhaps, on the whole, on the American seaboard, but the outstanding case of Chicago in the interior of the United States, with half-a-hundred busy crossings over the Chicago and Calumet rivers, has given rise to much study of the problem, resulting, as recounted in the article in this month's issue by Mr. D. N. Becker, in the evolution there of a special type of bascule bridge, which is now very largely adopted in Europe.

It would be idle to speculate on the original type of movable bridge over a waterway. Probably it was a bridge of boats, or pontoons, such as still remains in use mainly for military purposes, but also in some localities as a permanent means of trans-river communication. We have in mind, for instance ,the floating bridge over the Rhine, connecting Coblenz with Ehrenbreitstein, which we traversed a dozen years ago, on an occasion when we were held up for an appreciable interval on account of the removal of a section of the bridge to allow river craft to go through. There used to be similar floating bridges across the Golden Horn connecting Galata and Stamboul, where there is now a fixed bridge. Several other examples might be cited.

Another interesting early type was the drawbridge across a castle moat, essentially the forerunner of the pivoted bascule. In more recent times, say half-a-century ago, horizontal swing bridges were generally in existence at dock entrances and passages. Then, at the commencement of the present century, the bascule type came into prominence and was developed largely under the influence of Scherzer, Page, von Babo and others at Chicago. But we will leave this part of the story to be told by Mr. Becker.

Omitting the boat bridge as unduly slow and cumbersome, there are four possible types of movable bridges available for port waterways: the horizontal swing bridge, the horizontal drawbridge, the vertical lift bridge and the bascule, which last admits of sub-

Editorial Comments—continued

division into two distinct varieties, viz.: the pivot or trunnion type and the rolling type. Of these (except for pedestrian traffic) the horizontal drawbridge is attended by constructional and operational disadvantages; and the vertical lift bridge, though in evidence at Rotterdam as well as at Chicago and elsewhere, is not generally economical on account of the height of lift necessary to overcome its liability to foul the masts of shipping. Broadly speaking, the general types of movable bridges at dock entrances and passages are the swing bridge and the bascule.

Swing bridges were first in the field. The merits of the swing principle are a comparatively slight expenditure of motive power, the absence of deep pits for counter-balancing purposes and of appreciable variation in level. On the other hand, swing bridges are necessarily longer than bascules. The latter (if of the trunnion type—the rolling type has, of course, no pivot) may rotate on an axis as close to the waterway as is judged desirable. The pivot of a swing bridge has to be set back sufficiently far to admit of housing the full width of the bridge within the quay line. Another objection to the horizontal swing bridge is that the side recesses occupy a large extent of quay frontage and, in the case of wide passages, this leads to the necessity for side walls of appreciable length with correspondingly increased constructional cost, in addition to encroachment upon the dock area.

Dock Labour Re-arrangements.

During the past month, a new Essential Work (Dock Labour) Order, 1943, has come into force, superseding the original Order of 1941 and making certain important alterations in the regulations set out in the latter, due to the experience gained in working. The changes have been made by the Minister of Labour and National Service in consultation with the National Joint Council for Dock Labour and the National Dock Labour Corporation. The leading points of difference may be set out as follows; they are based on an analysis which appeared in *Lloyds' List*.

Under the original Order, the scope of a dock labour scheme for each port was determined by the definition of port transport work contained in the registration scheme under the Dock Labour (Compulsory Registration) Order, 1940. Under the new Order, the definition is to be set out in the dock labour scheme itself, and before the scheme and definition are approved, the Minister of Labour is required to take such steps as appear to him to be necessary to ascertain the views of the interested parties, and if he thinks fit, to appoint an impartial person to hold an enquiry into the provisions of the scheme.

Under the old Order, the maintenance of registers of port transport employers and port transport workers remained the responsibility of the Registration Committee, although the size of the workers' register has been determined by the National Dock Labour Corporation. Under the new Order, the maintenance of both employers' and workers' registers will become the responsibility of the National Dock Labour Corporation, but it will be open to the Corporation to maintain the existing Registration Committees as part of their organisation in any port in which this is generally desired.

The new Order has been brought into line with the General Provisions Order by the introduction of a clause, under which disobedience of lawful and reasonable orders, absenteeism and persistent lateness, become offences under the Order itself. Breaches of the scheme by employers are also now dealt with in the Order itself.

Under the old Order, it was an offence to employ any man other than a port transport worker on port transport work. Experience has shown that this provision may, in certain cases, prove wasteful of man-power. Under the new Order provision is now made for the employment, in certain cases and subject to proper safeguards, of men other than transport workers, on port transport work. The cases it is intended to cover are: (1) Certain undertakings whose main business is not that of port transport work and who desire occasionally to employ their regular weekly workers on port transport work; (2) It occasionally happens that a purely temporary shortage of dock labour in a port cannot readily be met by a transfer of men from other ports, either because such men are not at that moment available, or because, by the time they had arrived, the emergency would have passed. The new Order gives the Minister power in such cases to authorise the National Dock Labour Corporation to utilise temporarily the services of any other suitable men who may be available.

Copies of the Order (S.R. & O. 1943, No. 1114) can be obtained from H.M. Stationery Office, price 2d.

Patriotism versus Pay.

A curious case, recently decided in the Mayor's and City of London Court, throws an interesting light on a strange attitude of mind in workers in regard to their rights and obligations under industrial law.

In the case in question, a lighterman sued the National Dock Labour Corporation, Ltd., for non-payment of attendance money on three occasions on which he presented himself for work in accordance with the Essential Work (Dock Labour) Order, 1941, but refused to take the work which was offered him, on grounds which indicated that he was more concerned about a trifling inequality in pay for the job than either his legal liability to do the work, or his patriotic responsibility in the national emergency.

Under the agreement which he had signed he had undertaken to " accept any employment for which he is suited to which he is directed by the port manager in connection with port transport work." Quite ignoring this undertaking, even while going so far as to admit that the job was within his competence, he took exception to the fact that he was asked to work in conjunction with three other men who were on a different basis of payment and might therefore receive a little more pay than he would. There was no question that he would have received the pay to which he was entitled, but he rejected this consideration and preferred to advance a claim which was quite untenable, viz., to draw money for services which he had not only not rendered, but deliberately refused to render.

There is something in this extraordinary case which is a little reminiscent of the parable of the Labourers in the Vineyard (Matt. xx, 1-16) in which it will be recalled that an agreement voluntarily entered into by a first batch of labourers was subsequently criticised by them on the ground that others engaged later in the day were to be rewarded to the same extent. It illustrates a weakness in human nature, and particularly among some sections of the labouring classes, which allows the most trivial and selfish pecuniary consideration to supersede honourable obligations and patriotic duty. On the other hand, it must be admitted that there are many instances of remarkable self-abnegation and devotion among workers engaged in the national service and these are deserving of the highest commendation.

Harbour Moorings.

Another legal decision of interest and importance to Harbour Authorities, decided during the past month, was the case of the *Quercus*, a report of the judgment on which appears in this issue.

The essential point which the judge had to determine was whether there had been any culpable negligence on the part of the Corporation of Torquay in regard to the maintenance of one of their buoy moorings, so that its efficiency was thereby impaired and the mooring failed to come up to the implied guarantee that it was suitable for public use.

The judge had the advice of an Elder Brother of Trinity House, in whose view inspection of a mooring by a diver once a year, as testified in evidence, was not in itself sufficient. In his opinion, the mooring chain should have been unshackled, together with the swivel, and properly washed and inspected link by link. No doubt this course would have been more prudent and reliable, but we are inclined to wonder whether it is not a counsel of perfection. To detach a mooring from its anchorage and replace it is a troublesome operation. In current practice we imagine that it is not often, or regularly, done, and that the haulage of a chain to the surface of the water, with a careful inspection of so much of the submerged cable as is thereby rendered visible, is often considered sufficient evidence of the general state of the chain. Such inspection cannot, of course, claim to be complete, since local flaws may develop under water out of range of so superficial a survey. The decision in the *Quercus* case must be taken as an indication to harbour authorities that they can only escape liability for consequent mishap to moored craft by a most thorough and precise examination of their mooring chains.

Greenock Harbour

Scheme of Port Development, set out in Report to the Harbour Trustees

By DONALD SMITH, M.Inst.C.E., General Manager and Engineer.

PROPOSALS for the post-war development of the port and harbour of Greenock were submitted in March last by Mr. Donald Smith, general manager and engineer, to the Trustees in a Report, the essential sections of which are reproduced below.

After a preamble setting out the circumstances under which a Special Committee was set up to take into consideration possible future port developments at Greenock, the Report continues as follows:

Alternative Bases for Development.

The Committee had to decide the basis on which any post-war development of the Port should proceed; firstly, whether such a scheme should be limited to ordinary small scale improvements to meet local needs and the normal working of the Port, or secondly, whether by virtue of its geographical position, and estuarial advantages the Port of Greenock should be developed into a major deep-sea Terminal Port and as a Naval Base on the lines of national requirequirements. After giving full and careful consideration to all the various factors bearing directly on a decision between the two broad principles on which developments should proceed, the committee came to the conclusion that, with the extraordinary advantages of the geographical position of Greenock, both from a trading and national defence point of view, which has been abundantly proved during this and the last war, the port and harbours should be developed on bold lines compatible with the natural facilities of the Estuary on which they are situated and as a modern deep sea port of a national status.

Mr. DONALD SMITH, M.Inst.C.E.

Transatlantic Services

There should be provided facilities for Atlantic and other liners to land their passengers and take in supplies so as to save time in the difficult and slow passage to and from Glasgow and which, in time of war, might become blocked. With proper accommodation Greenock should be the terminal Port for the North American Mail Service, thereby saving about two days on the present service round the South of Ireland to Liverpool. It is realised that to reap the full advantage of this scheme, some arrangement would have to be come to with Glasgow to prevent detrimental competition for trade with Greenock and to co-ordinate the traffic coming to the Clyde. Geographically, Greenock is ideally situated for a Naval and Seaplane Base—a broad expanse of water practically land-locked—a splendid anchorage—rail and road connections—shipbuilding and engineering yards capable of carrying out any repairs. The committee, having considered the great natural possibilities for the development of the Port of Greenock on the lines indicated above, instructed the General Manager and Harbour Engineer to design a scheme and prepare general plans accordingly.

Existing Accommodation

The present Port and Harbours are comprised of one modern wet dock at the eastern end, the James Watt Dock, with 28-ft. of impounded water level and equipped with up-to-date facilities, making it the hub of the present system. The James Watt Dock should, therefore form the basis for any developments in the Great Harbour area. The remaining harbours, the Victoria Harbour, East India Harbour, the riverside berths, the Albert Harbour and the Princes Pier, with the exception of that portion now under reconstruction, are, however, all ancient structures, rather haphazard in design and lay-out, some of them falling into decay. Depth of water at L.W.O.S.T. in these harbours provides only for coastwise traffic, with the exception of the Deep Water Berth East of the Princes Pier. Part of the Princes Pier is now under construction at a cost of about £200,000, and for the western sections these new works should be used as the base line for future port developments.

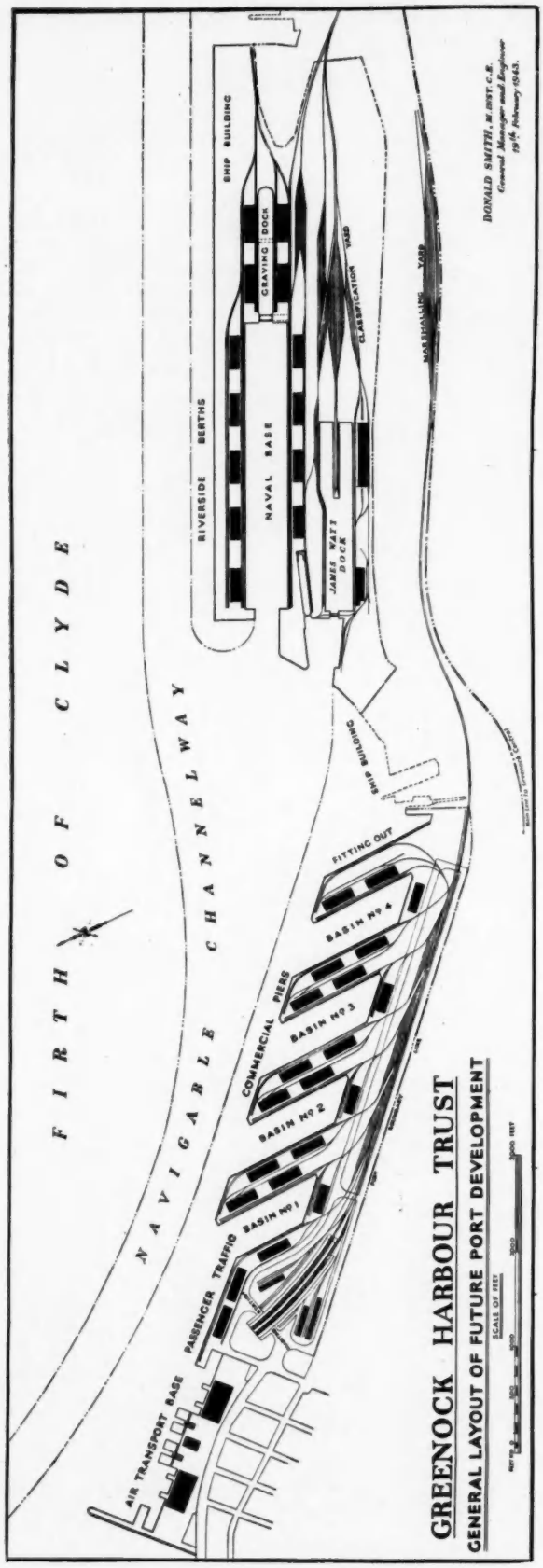
The geographical position of Greenock is unique. It is immediately adjacent to a magnificent anchorage, practically land-locked, access from deep water to the James Watt Dock being very easy. Its estuarial position on the southern bank of the navigable channel indicates a system of piers for the western or commercial section with corresponding rail facilities from the landward area, whilst the Great Harbour area, in view of its slightly greater projection into the River Clyde, can best be developed by the wet dock system, parallel and related to the existing James Watt Dock, and with these basic principles in mind, drawings showing the possible future port of developments in the Greenock area have been prepared accordingly.

Air Transport Base

The Air Transport or Flying Boat Base is oriented on plan to the west of the existing Princes Pier in view of the suitability of this site. This position gives direct access from the " landing " water area west of the Tail-of-the-Bank; it is adjacent to the

Princes Pier, Greenock.

Greenock Harbour—continued



Princes Pier Railway Station, and air traffic can be linked up with the Transatlantic and other ocean or coastal passenger traffic at the Princes Pier and Basin No. 1, on the assumption that air transport of the future will be closely related to sea transport, particularly with regard to passengers and light goods traffic and that both will be under the same government department, probably the Ministry of Transport. A protecting mole, transhipment pier, boat jetty, pontoon landing stages, slipways, hangars, workshops and administrative buildings comprise the air transport section.

Passenger Traffic

The passenger traffic section, ocean and coastal, is located at Princes Pier and Basin No. 1, in conjunction with the remodelling of the Princes Pier Railway Station, which would, of course, be carried out under the auspices of the operating railway company, showing provision for Customs sheds, baggage examination and waiting rooms and railway platforms at the maritime station. The commercial piers are shown to the eastward of the passenger section, each pier providing accommodation for four ocean-going vessels with the requisite transit sheds, warehouses, and proper rail connections. Pierhead and basin-end berths are intended for coastal traffic, while the end side berths of the easternmost pier may be reserved for fitting-out purposes.

Proposed Naval Base

Recent events have led to the conclusion that a portion of the future developments should be allocated as a Naval Base and Dockyard, as shown on plan in the Great Harbour area north of the James Watt Dock. This portion of the scheme consists of main dock for capital ships; large graving dock to accommodate battleships, aircraft carriers and vessels of the *Queen Elizabeth* class; riverside berths for cruisers and lighter craft; warehouses, transit sheds, stores work-shops and a repairing establishment. If required, the extreme eastern end of this area can be reserved for shipbuilding. In the absence of naval developments, this dock system would be admirably suited to ocean-going traffic of any kind.

Rail Connections

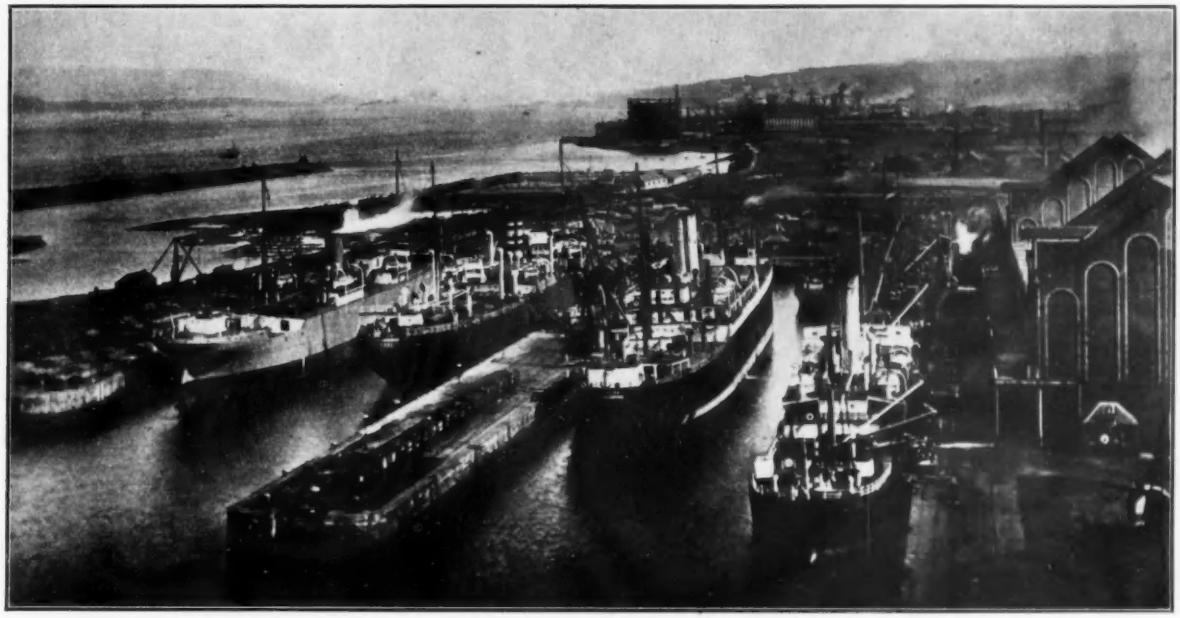
In the past, the whole of the Greenock area has suffered from a lack of modern railway facilities and access and egress to and from the western sections of the harbour undertaking are carried out under very difficult conditions, whilst the eastern area, although better served, was also designed to meet railway requirements of half-a-century ago. A port development scheme, even with excellent approaches from the sea, can be of little use if it is not adequately served by road and rail transport. It is not, therefore, surprising to see a comprehensive scheme for the development of the port and harbours of Greenock area as a whole, having within its scope a major scheme providing for railway improvements and adequate marshalling facilities. The proposed arrangements have the advantage of doing away with the railway approaches in the eastern part of the town and reducing the local crossings to a minimum.

The Navigable Channel

The navigable channel, as shown in the proposed scheme, is further riverwards, but both its curve and proximity to the new works are maintained. This navigable channel is of such vital importance to the welfare and very existence of the Port of Greenock that the full protection of the estuarial sandbanks, known as the Greenock, Cockle and Pillar Banks, is of paramount importance and it should be understood that the development works shown on the accompanying plan incorporate the reservation of all navigational rights in the entire estuary from shore to shore under the jurisdiction of the Greenock Harbour Trustees, having associated with them the other statutory authorities concerned.

The Report concludes with a recommendation of the Special Committee that it be transmitted to the Ministry of War Transport through the Regional Port Director for Scotland.

Greenock Harbour—continued



James Watt Dock, Greenock.

Notable Port Personalities

XXXVIII—Mr. G. S. Szlumper, C.B.E.

Mr. Gilbert Savil Szlumper, C.B.E., recently Director General of Supply Services, and since 1942, discharging special duties on behalf of the Railway Companies' Association, is well known in port circles as a former Docks and Marine Manager at Southampton of the Southern Railway Company.

Mr. G. S. SZLUMPER, C.B.E.

The son of Mr. Alfred W. Szlumper, C.B.E., he was born in 1884, and educated at King's College School, Wimbledon, and at King's College, London.

In the course of long service with the London and South Western Railway, Mr. Szlumper became Docks and Marine Manager in 1920, retaining the position until 1925, when he was appointed Assistant General Manager of the Southern Railway, and, in 1937, was promoted to the General Managership, vacating it in 1939, to take up supervision of transport work on behalf of the Government.

Mr. Szlumper held commissions as Major (1916) in the Engineer and Railway Staffs Corps (T.A.), Lieut.-Colonel (1928), Colonel (1937) and is the proud possessor of the T.D. As Controller of Railways under the Ministry of War Transport, he received the rank of Major-General in 1939. He is a Member of the Institution of Civil Engineers and a Past President of the Institute of Transport.

Langston Harbour and Air Transport.

The Portsmouth City Council have recently had under consideration the possibilities of Langston Harbour as a base for Empire air services. They have received assurances from the Director-General of Civil Aviation that when the Air Ministry are ready to deal with civil aviation, very careful consideration would be given to the Langston Harbour project.

Leith Dock Commission and Edinburgh Development.

At a meeting in July of the Leith Dock Commission under the chairmanship of Mr. Hugh Rose, there was submitted the draft report by a special committee of the Commission, on the question of post-war development of the City of Edinburgh, and it was considered in detail. The Commissioners stressed the need for housing facilities for dock workers being within reasonable walking distance of the docks, while at the same time they realised the importance of setting up new industries in the neighbourhood of the port. They pointed out their special interest in the sea-borne traffic to and from the port, and noted that the establishment of new industries would be of great advantage to the shipping and commercial community.

As to the question of Edinburgh's position as a centre of historical and architectural importance, they considered that that could be best left in the hands of a permanent committee specially appointed and consisting of experts.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

Model Prototype Conformity in Interesting Cases of Lock Construction

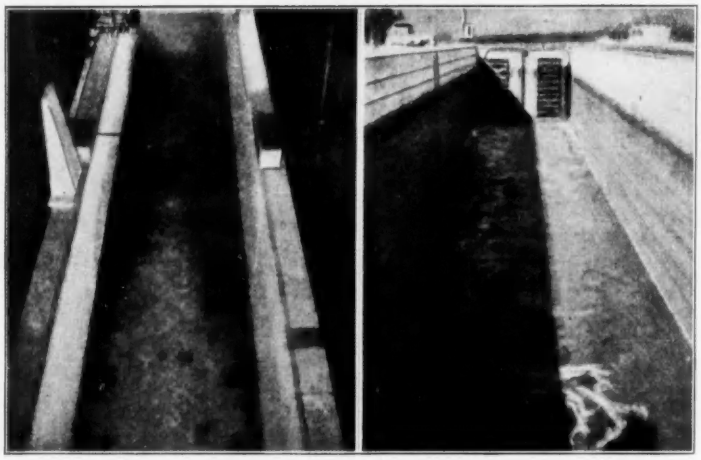
By MARTIN E. NELSON, M.Am.Soc.C.E., and JAMES J. HARTIGAN.

(Concluded from page 94)

Discussion

Mr. A. E. Niederhoff, Assoc.M.Am.Soc.C.E., Senior Structural Engineer, U.S. Engineering Department, wrote as follows:—About the only thing that can be added to the thorough and fine paper by Messrs. Nelson and Hartigan is to call attention to corroborative evidence found on the West Coast. This evidence concerns two high lift locks with lifts of 66-ft. and 45-ft. respectively.

The authors have revealed the fact that, where geometric similarity does not exist between model and prototype, correlation of test results is difficult. Of this there can be no doubt but since total similarity, geometric and dynamic, can never be obtained when the same liquid is used in both model and prototype, one should not be too disturbed at failure to obtain exact quantitative results. After all, a model of any kind is not the answer to all questions on a subject. At the risk of seeming irreverent, the writer calls attention to the model husband who has been defined as " a small imitation of the real thing." Hydraulic models fall in the same category, and engineers do well to observe trends and characteristics in a model that are duplicated in the prototype. Actual measurements of time, velocity, forces, or discharges are done best on a full-size lock for possible design use on a similar structure.



(a) Model (Head 47.6-ft.). (b) Prototype (Head 49.0-ft.).

Fig. 16. Disturbed water condition when Lock-Chamber is being filled.

Fig. 16 (a) shows the filling of a model lock, utilising a floor culvert and port system patterned after one of the locks discussed herein (66-ft. lift). The same water disturbance in the model chamber will be observed in the prototype (see Fig. 16) (b) especially at the far end, near the lower mitre gates. Also, when emptying the model chamber, the fountain effect below the lower mitre gates is duplicated every time the 66-ft. lock is emptied. It is interesting to note that, in spite of lack of exact similarity, the co-efficient of filling for the model and prototype agreed within 1%. An average co-efficient of filling was 0.83, and, for emptying, this co-efficient dropped to 0.72.

Hawser stresses in model lock chambers have been measured as a criterion for proper functioning for several years. However, to the writer's knowledge, only one attempt to measure hawser stresses has been made on a high lift lock. In 1940 a government derrick boat was moored by four lines to floating mooring bits in the 66-ft. lock. Dynamometers were placed in these lines and readings were taken simultaneously at each 5-ft. of lift. When plotted as a curve, the results showed that the maximum pull occurred when the valves were fully open, and when discharge into the lock was a maximum. The curves showed the same family characteristics as those obtained in a model even if the actual magnitude of the pull on the lines was considerably greater than that shown in the model.

The distribution of water from ports in a lock chamber has been ably described by Messrs. Nelson and Hartigan, and it is only in deference to Southern California that the writer wishes to point to the full-scale results of the " manifold problem " investigated at the second high lock mentioned herein (45-ft. lift). Southern California was a factor in this test because the grape-fruit used as floaters came from Coachella Valley. These juicy, yellow spheres were placed just upstream from the filling valves, and timed and counted as they emerged from the several chamber ports. In this particular case, most of the grapefruit, and therefore most of the water, came from the port farthest upstream in the chamber.

Model tests have shown the necessity for relieving entrapped air in a culvert system if the lock is to be filled efficiently. The conditions at the 45-ft. lock at the time of conversion from a tandem lock to a single lift of 45-ft. were such that only one large vent hole per culvert could reasonably be drilled. This hole was 20-in. in diameter. When completed, it worked beautifully, sending a geyser of air and water 60-ft. into the air above the top of the lock-wall and adding another spectacle to the scenic beauty of the region.

When the diameter of the vent hole was reduced to 10-in. by placing a pierced diaphragm over the end of the vent pipe, the water no longer shot out of the vent pipe, but entrapped air exploded into the lock chamber. Cutting the effective vent hole to a diameter of only 4-in. merely made the chamber explosions more violent and more prolonged.

**Reproduced from the Minutes of the American Society of Civil Engineers, October, 1942.*

Swedish Harbour Development

Extensions at Port of Trelleborg

The Trelleborg Harbour Board (Sweden), has recently completed plans for the final stage of the extensions scheme prepared 20 years ago and already partly carried out. The proposal contemplates the moving of the entrance channel piers about 150 metres further out to sea, the extension of the harbour area and the dredging of the harbour and entrance channel to give a depth of 8 metres. The scheme, which forms part of the Government's plans for improving Swedish harbours, also takes into consideration the Swedish State Railways' plans for extending the ferry traffic after the war, using longer ferries, which will require better entrance facilities and larger ferry berths.

The work includes an extension of the eastern breakwater and pierhead to a length of 488 metres, and of the western breakwater and pierhead at 485 metres. The cost is estimated at 946,000 kroner and 831,000 kroner respectively. The entrance channel and the harbour basin as far as a line drawn from about the end of the central quay will be deepened to 8 metres, while the northern part of the eastern harbour basin will be dredged to 7.5 metres so that large vessels can go alongside the new warehouse and cold store. The deepening of the entrance channel to 8 metres will extend for a total distance of 1,650 metres, for a breadth of 80 metres for the first 1,000 metres and a breadth of 100 metres thereafter. The dredging of the harbour basin is estimated to cost 806,000 kroner, and the deepening of the entrance channel 694,000 kroner. The total estimated cost is thus 3,277,000 kroner. It is not intended that the whole of the scheme should be put in hand at once; work on each part will be started when conditions appear favourable.

The Board Room.

The Board Room of the Clyde Navigation Trust

Through the courtesy of the Clyde Navigation Trust we are able to show a view of the Board Room with the members in session.

The photograph was taken at the close of the Trustees' meeting on 3rd August, showing Mr. William Cuthbert, Chairman: on his right, Mr. James Leggat, Deputy-Chairman, and on his left, Mr. John Wilson, General Manager and Secretary. From the right in outer ring of desks are seated Mr. Robert Galloway, Mr. William E. McCaig, Mr. James Gilchrist, D.L., LL.D., Mr. John MacLean, Mr. Claud A. Allan, Mr. John Hay, Mr. Barclay Hogarth, Mr. W. H. Rutherfurd, Sir George A. Mitchell, D.L., LL.D., Sir Patrick J. Dollan, D.L., LL.D., Sir Thomas Watt, Mr. Andrew Hood, Mr. William Reid, Mr. J. A. Ralston Mitchell, Mr. William Elger and Sir John Stewart, D.L., LL.D. On the inner ring from the right are Mr. Charles Connell, Provost Alister M. Macphie (Dumbarton), Mr. Fred C. Stewart, D.L., Mr. Peter Baxter, Mr. John S. Ratcliffe, Mr. John S. Clarke, Mr. Robert Robinson, Provost James Lang (Renfrew), and Mr. J. Wilson Paterson, and in front of the Chairman, Mr. Robert Millar, Assistant General Manager and Mr. James Logan, Assistant Secretary. Seated between the pillars in the centre of the photograph are the following officials: Dr. George Buchanan, Medical Officer, Captain John W. Eaglesome, Harbour Master and Traffic Superintendent, Mr. R. O. H. Baxter, Granary Superintendent, Mr. James Macfadzean, Engineer, Mr. John McLellan, Lairage Superintendent, Mr. William A. Oliphant, Mechanical Engineer, Mr. Alexander S. Grant, Collector, and Mr. William L. Wilson, Treasurer.

The Trustees' Hall is situated beneath the dome and on the second floor of the building, erected in 1908, as an extension to the building as then existing, with frontage to Robertson Street and to the Broomielaw which borders the upper reach of the River Clyde. A photograph of the building is shown on this page. The corridor leading to the Hall is panelled in teak and finished with graceful pilaster treatment. It has a lofty domed ceiling. Three large windows, having Coats of Arms in colour in the centre, light the corridor. At the end of the corridor an ornamented doorway leads to the Trustees' Hall. The Hall is circular in form, with seating accommodation for the members of the Trust. The seats of the Chairman, the Deputy-Chairman, the Lord Provost and the General Manager are arranged in front of the recess immediately to the left on entering.

With regard to the architectural design of the Hall, marble columns form the basis of the scheme of treatment, and all the other fittings are in harmony therewith. The columns, which have bronze capitals and bases, support a finely-moulded and enriched cornice extending two-thirds distance round the Hall.

In the wall, behind the Chairman, is a window with richly modelled trusses, and the Coat of Arms of the Trustees. Three

The Building.

large windows light the Hall. The ceiling is richly moulded and electric lights have been incorporated with the foliage of the moulding. Round the walnut dado, with an ebony lower panel, is a richly-carved moulded frieze.

Adjoining the Trustees' Hall are the Committee Rooms. The architect was Sir John James Burnett, A.R.S.A.

Notes of the Month

River Wear Commission.

Mr. Michael T. Brydon has been elected a member of the River Wear Commission in succession to the late Mr. Robert Hyslop.

Dock Strike at Liverpool.

A dispute about payment for overtime work caused a strike of several thousand dock labourers at Liverpool, which lasted about a week in the middle of August before the men returned to work.

Retirement of Harbour Master.

Mr. J. L. Williams, Harbour Master at Bombay, has retired after nearly 23 years service as Pilot, Master Pilot, Dockmaster and finally Harbour Master, to which last post he was promoted on 9th October, 1941. His successor is Mr. C. R. M. Thomas.

Proposed Free Port at Beira.

A conference has been held at Beira, Portuguese East Africa, attended by delegates representative of that colony and of Northern Rhodesia and Nyasaland, for the purpose of considering the establishment at Beira of a Free Port. The delegates are to report to their respective governments.

Use of Dock Dredger in Theft of Foodstuffs.

Quantities of foodstuffs missing from a Liverpool dock warehouse at the end of July were found on a dredger which had been transferred to another dock on the Birkenhead side of the river. Thirteen members of the crew were charged with " feloniously receiving " the foodstuffs; two were discharged and the remainder fined various amounts ranging from £3 to £20.

Port of London Finances.

An issue of £1,700,000 of 3½ per cent. stock, redeemable 1966-1971, has been created by the Port of London Authority to permit the repayment of temporary loans already incurred for capital expenditure. The stock was placed at the price of 101. Interest will be payable half-yearly on March 1st and September 1st, a first full six months' interest being payable on March 1st, 1944.

Dock Supervisors at Port of Bombay.

The matter of dock supervision at the Port of Bombay having been under consideration, the Trustees, in order to assure more efficient control of the traffic passing through the port, have sanctioned the appointment of 26 dock supervisors. The principal duties of these officers will be the distribution and delivery of cargo, proper stacking, off-loading of heavy packages and general supervision of labour.

Expansion of Californian Harbour.

Plans for the expansion of Long Beach Harbour, California, U.S.A., over a period of 25 to 30 years at an estimated cost of 35 million dollars were submitted recently to the Long Beach City Council by the Harbour Commission. The scheme would add 620 acres of developed area to the port, of which 360 acres would be land. There would be provision for 34 additional ship berths, 18 acres of quayside sheds and 9 acres of warehouses. It also contemplates a 200-acre seaplane basin.

Proposed Italian Inland Waterway.

A project for an inland waterway to link up the port of Venice with the town of Locarno at the head of Lake Maggiore has been revived and discussed at a meeting of the Locarno-Venice associations which was attended by Swiss representatives and held in Venice a short time ago. The waterway, which would connect Lake Maggiore with the Adriatic via Milan, Cremona and Mantua, would be about 500 kilometres long. Estimates prepared in Italy in 1941 showed that the cost would be about 2,500 million lire, but wages and the price of materials have increased since then. The project contemplates a canal 30 metres in width at the surface of the water and with a depth of 3 metres. The main part of the waterway would be some distance north of the River Po.

Death of Harbour Master.

Mr. Daniel Tolmie, harbour master at Burghead, since 1929, has died at the age of 59.

Removal of Sheerpoles at Aberdeen.

The old sheerpoles erected in 1874 at Aberdeen, adjacent to the dock gates, are being dismantled. The metal is to be used for war purposes. The later and more powerful sheerpoles are to remain.

Irish Harbour Finances.

Owing to having exceeded its permitted overdraft, the Galway Harbour Board is approaching the Eirann Ministry of Finance for financial assistance. The Buncrana Harbour Board have suggested that a moratorium should be sought on loan payments.

Norfolk Coast Erosion.

The East Norfolk Rivers Catchment Board have under consideration a scheme for dealing with coast erosion in the neighbourhood of Caister. The scheme covers a length of 3,300 yards at a cost of £498,685 and is to provide protection of the coast railway adjacent to the defences at Great Yarmouth in an area where the sea makes persistent and heavy onslaughts.

New Dock Labour Regulations for Halifax, N.S.

The Canadian Minister of Labour has issued two Orders in Council designed to improve the handling of cargoes at the Port of Halifax, Nova Scotia. One of the orders prohibits a " longshoreman " (docker) at Halifax from leaving his job without a Selective Service special permit and the other establishes a labour reserve pool of longshoremen.

Danish Port Traffic.

In the first quarter of this year 9,500 vessels, of 1,440,000 tons net, arrived in Danish ports; they discharged 1,900,000 tons of cargo, and loaded 977,000 tons. In the fourth quarter of last year, 13,400 vessels, of 1,480,000 tons net, arrived in Danish ports; cargo discharged totalled 2,040,000 tons, and cargo shipped 1,020,000 tons.

Trelleborg Harbour Improvements.

The Harbour Board of the Swedish Port of Trelleborg have recently completed certain extensions, including the erection of a block of buildings containing a warehouse and cold store. The warehouse is of reinforced concrete construction and has a floor area of 1,500 sq. metres while the cold store has a floor area of 750 sq. metres. The latter comprises 15 cold rooms on five floors.

Post-War Development at Hull.

In connection with post-war planning proposals at the City of Hull, it is stated in *Modern Transport* that there are under consideration plans for " an extension of the King George Dock, the joining of all docks in the port so that ships and lighters could be moved from one dock to another at any state of the tide, and a main road and a main railway running along the entire river front so that traffic could travel direct from Salt End to Hessle without having to filter through the city."

Norwegian Harbour Limits Extended.

As from 1st June last the boundary of the Harbour of Haugesand, on the West Coast of Norway, has been extended and they now include the waters between the island of Karmöy and the mainland within the following limits:—In the north, a line from Haugeklubben on the mainland, near Sörhaugöy Light, to the entrance to Sjursundet, through this to the western end of Garsöy and the north-western end of Vibransöy, thence to the western end of Trollholmen and to Vikiklubben, near Osnesgavlen Light on Karmöy; in the south, a line from the mainland through the northern end of Buköy to Karmöy in the direction of the tower of the church at Avaldsnes.

Quayside Cranes and other Cargo Handling Appliances at Ports

By J. DALZIEL, M.I.E.E.

(Continued from page 89)

Luffing. Level-luffing Devices

LUFFING or derricking is the radius adjusting motion effected by rotating the jib in a vertical plane round the pivot pin at its base. This is in general operated by wire ropes attached generally to the jib head, but sometimes to a lower point and worked from a winch in the upward direction, the jib lowering itself by its own weight under the control of the ropes and winch. The motion may be otherwise operated, for example, by screw and nut gear transmitting pull and thrust through a solid or tubular rod connecting the nut to the jib head. This is the usual arrangement in the case of very heavy capacity appliances, e.g. shear-legs. The movement may also be operated by crank, or by circular sectors geared to a motor. Level-luffing is the term applied to this motion where, by the embodiment in the crane design of compensating means of one of the various types, during the process of luffing the load on the lifting rope traverses in or out at the same level throughout or approximately so. In early cranes not embodying such compensating gear luffing entailed a considerable rise in height of the load as the jib came in and the jib head rose; the amount of rise was that of the rise in height of the jib head less such length of the lifting rope as was paid out over the jib head pulley by the shortening of the distance between that pulley and the fixed pulley on the revolving super-structure of the crane. This shortening varied with the design of the crane following the relative positions and heights of the jib head pulley, the fixed pulley and the jib pivot pin. Where the super-structure supporting the fixed pulley was carried up very high as e.g. in the Scotch derrick so as to be approximately the same height as the mean height of the jib head, the rise and fall of the load was inappreciable so that level-luffing was practically attained; in fact, an actual drop on the load as the jib rose could be arranged.

But though this arrangement has been successfully embodied for level-luffing in the case of many cranes and the absence of complications of any kind at the jib head is an advantage, the carrying up of the superstructure to a height so great as that of the jib head in many modern cranes is not practicable.

Further while in the writer's view it is not essential that the load should be kept at a dead level throughout the range of luffing, it is not possible with this arrangement to keep it sufficiently at the same level when the range of luffing is long. Other schemes providing for level-luffing, with more conventional designs of superstructure and height of the fixed pulleys thereon were evolved a number of years ago, notably by Messrs. Babcock and Wilcox with their articulated jib, and by Messrs. Stothert and Pitt with their "Toplis" gear

The importance of providing for level-luffing which led to the evolution of these designs is that, whereas with ordinary luffing the rise of the load as the jib rises sets up a heavy power demand and *vice versa*, its fall with the lowering of the jib entails a large measure of control with the possibilty of the jib taking charge under some conditions; with level-luffing all the power required is that for overcoming friction and there is no tendency arising from motion of the load for the jib to move in either direction.

Not only is there a much higher power efficiency but the effect of the much higher speeds and fuller control of the motion rendered possible, is to make luffing a much more effective motion in the operation of the crane enabling it to be used not as a mere means of adjusting radius only, but in the course of dealing with each lift to clear superstructure, other cranes, or other obstructions and to enable cargo to be loaded or unloaded to points of different radius speedily and flexibly.

Whereas luffing speed in the case of non level-luffing cranes is necessarily very low on account of the risk of the jib taking charge, with level-luffing gear in use, the speeds may run up to 200-ft. per minute.

Fig. 4. 10-ton Level Luffing Crane, Messrs. Stothert & Pitt (Toplis gear).

It is also possible to increase the range of luff to a considerable extent, the range being in some cases as much as 45-ft. on a crane of 70-ft. extreme radius.

Some Continental crane designers go to great elaboration in their luffing gear (see Fig. 3), presumably to attain a dead level, but both the "Toplis" and the Babcock and Wilcox gear effect this much more simply.

Let us deal first with the "Toplis" gear (which can be clearly seen in Figs. 4 and 6) as being to some extent related to the Scotch derrick arrangement, in that it is based on suitably fixing the relative positions and arrangement of the jib head pulleys, the fixed pulleys on the revolving cab superstructure, and the pivot

Quayside Cranes at Ports—continued

at the base of the jib. These are such that, as the jib rises, the rise of the jib head is 3 times the amount by which the distance between the jib head pulley and the fixed pulley shortens. Compensation is effected by carrying the lifting rope from the jib head back to the fixed pulleys and thence back again and down to the lifting hook; there are thus three falls of the rope and the amount of shortening as the jib rises is accordingly multiplied three times at the lifting hook which is thus maintained level.

A feature of the "Toplis" crane is that as the pull on the lifting rope is constant, and it can be arranged that the ratio of the jib-weight by its movement to the lifting rope pull by its movement is also constant, a constant weight rising and falling vertically will balance the jib in any position. This weight is suspended and operated by ropes carried from the luffing winch barrel and is usually carried in vertical guides providing for its requisite rise and fall and placed at the back of the revolving superstructure.

The Babcock and Wilcox device is of a different type and principle. It is well illustrated as embodied in the crane shown in Figs. 5 and 7. With it the lifting rope runs over and descends from a pulley carried on a folding lever hinged to the top of the jib proper. The back of this lever is cam shaped and a rope or ropes pass over the cam, which is shaped so that the action of the ropes is to raise or depress the point of the lever as the jib is luffed down or up by the correct amount to keep the lifting hook level or approximately so. Actually, in general a slight lift at each end of the luffing range is provided for and it is claimed that it is an advantage given by this that a rise in power takes place as the limits of the luffing range are approached.

The ropes from the cam are led to, and attached, at the top of the revolving superstructure of the crane. They are purely guy-ropes and do not wind in or out, their action being entirely automatic; as the jib moves out the guy-ropes stretch out the lever appropriately and vice versa in the reverse direction allow it to fold down.

Balancing of the jib in the case of this type of crane is effected by a counter-balance weight carried at the rear of the revolving superstructure, and generally in the form of a box filled with scrap suspended on a pivot, and rising as the jib descends and vice versa. To provide against the increase in the moment of the jib weight round its pivot as it descends the counter-balance weight is also moved outwards as it rises.

Advantages claimed for the Babcock and Wilcox luffing gear are, that owing to the absence of rope movement and sheave rotation during luffing, it is extremely efficient, that the downward movement of the jib head during luffing maintains the length of rope between the load and the jib head at an approximately constant minimum, which is certainly an advantage, in a wind particularly, and that the articulated lever lib gives added clearance as compared with the straight jib for bulky loads which are to be carried up near the jib head, especially at maximum radius.

There are various other methods of obtaining level luffing. For example, in the case of double purchase cranes in which the lifting rope is passed over a sheave carrying the lifting hook and is returned to the machinery house, level-luffing is effected by bringing this end of the rope back to the luffing barrel and winding it on, or releasing it from, an extension thereof of such dimensions that the amount paid off, or wound on, is that required to keep the load horizontal. The relative positions of the jib head pulleys, the fixed pulleys on the super-structure and the jib pivot must be suitably chosen in relation to the amount of rope to be wound on or vice versa.

A somewhat similar arrangement is applied on ordinary single rope cranes in some cases where the luffing gear is coupled up to the main winding drum in such a way as to pay out the requisite amount of rope and *vice versa*, as luffing takes place. This is not an ideal arrangement, but can give sufficiently satisfactory results with a moderate range of luffing.

Rope operation of the luffing gear was universal with early cranes, and with level-luffing cranes in their early stages, but according to the writer's recollection, during or shortly after the last war, a new method of operating the luffing gear by cranks and connecting rods was evolved. The jib was suitably pivotted, generally from a point on the structure considerably higher than with the rope type of luffing operation and was balanced by weights attached to its bottom end, which were fixed relatively to the jib itself, ropes being thus eliminated both for luffing and for balancing the jib. The throw of the crank must, of course, be suitably dimensioned to give the required range of luffing, and the motion may be continuous, no limit switches for example being required. The movement is slow near the maximum and minimum radii, and fast at the centre of the stroke.

The moments respectively of the jib weight and the counter balance weight round the jib pivot can be suitably co-related by choosing the proper relative positions without any lever movement of the balance weight. The cranes illustrated in Figs. 5 and 7, have crank-operated luffing jibs.

With a similar arrangement of jib luffing can also be operated by rack and pinion gear, the rack being of course a sector of a circle formed round the bottom of the jib, instead of by crank and connecting rod (see Fig. 6). With all crank luffing gears, shocks are liable to be set up in starting and stopping, or reversal of motion and cushioning springs should be provided at some suitable point to take charge of the effect of such shocks. These springs should be placed so as to be easy of access both as regards their position on the crane and in regard to their extraction and replacement in the event of breakage.

Modern Improvements

In the most modern cranes it is the practice to enclose gear fully and in some cases to run it in an oil bath thus formed. Worm gear is also occasionally fitted and is, of course, totally enclosed, running in an oil bath and fitted with ball or roller bearings with, in especial, a ball or roller bearing taking the thrust. The gear is, of course, quick thread high efficiency type with a comparatively low reduction ratio.

It is a modern tendency to use ball and roller bearings extensively. Brass bearings are in general grease lubricated excepting where reservoir bearings with ring oilers are in use, e.g. on the motor shafts. The writer prefers grease lubricators to be of the Stauffer screwdown type rather than anything of grease-gun type, as requiring less time and attention excepting at long intervals when refilling is required.

An installation of modern straight general cargo cranes is illustrated in Fig. 6, showing a number of 3-ton and 5-ton cranes by Messrs. Cowans Sheldon and Company supplied to a British Railway, there being thirtv three 3-ton and four 5-ton cranes.

The cranes are provided with lifting, slewing, luffing and travelling motions, there being two lifting speeds.

The range of lift is 70-ft. above rail level and 30-ft. below at a speed of 200-ft. per minute for 3-tons and 400-ft. per minute for 1½-tons, which latter speed is very seldom used. The 5-ton speed is 140-ft. per minute and 2½-tons at 240-ft. per minute.

Luffing is 150-ft. per minute for 3-ton lifts and 140-ft. per minute for 5-tons from a minimum radius of 20-ft. to a maximum radius of 60-ft.

Slewing on the maximum radius is at 600-ft. per minute on the 3-ton and 450-ft. per minute on the 5-ton cranes.

Travelling is at 70-ft. per minute with no load in each case and on track rail centres of 15-ft., the 3-ton cranes having a wheel at each corner of the carriage, 4 wheels in all, and the 5-ton cranes 2 wheels per corner, 8 in all.

The height of the driver's platform is about 40-ft.; the roller path is of the live roller type; level-luffing is effected by the three fall rope method similar to the "Topliss" design.

Control is by drum-type controllers and braking by solenoid brake with mechanical release.

There are other and special types of quayside crane which will be referred to and described later.

Layout: Location of Cranes for Heavy Lifts

In the layout of the cranes due regard must be had to the probable nature of the cargos to be handled. It is general now-a-days to lay out the cranes on the quayside so that at least two

Quayside Cranes at Ports—continued

can be conveniently operated into each hatch with a minimum liability of their fouling each other. There is a question as to whether the cranes should be of mixed, or of uniform capacity, a decision as to which will rest mainly on local conditions. There is a further question as to the appropriate position for and method of use of the ultra heavy cranes required to deal with special heavy loads. If these very large cranes are located among those of smaller capacity for dealing with ordinary general cargo, they will assuredly impair the loading ability of the berth they occupy. By fitting them specially with light load barrels they can be used to assist the other cranes in dealing with the regular work of the quay, but it is, to say the least, unlikely that they can handle anything like the same tonnage per hour as the latter or be as convenient in operation, in view of their much greater bulk and weight and general comparative unhandiness. They are likely also to be different in construction and operation, requiring possibly a different guage of crane track, such as to preclude their being travelled along the quayface in the same way as the general cranes among which, in any case, they must retain a fixed position and whose movements they may obstruct. While taking up a crane berth, therefore, they will reduce its useful capacity considerably and with it the useful output capacity of the quay.

Their being placed in a special position elsewhere has the disadvantage of requiring the ship to be moved to them for the loading or unloading of any load or weight too heavy or too large to be dealt with otherwise, but a suitable time can be chosen for the ship to be moved, probably in most cases after it is finished at the general cargo berth, or before it goes there, and all the special appliances and tackle requisite for dealing with such exceptional loads can be conveniently stowed in the near vicinity under this arrangement.

What would appear to be a very effective scheme is that of the 80-ton crane by Messrs. Babcock and Wilcox illustrated in Fig. 7. In this case the crane travels at right angles to the usual direction i.e., it is run back away from the quayface and clear of the lighter general cargo cranes. The crane runs on double rail tracks the top of its rails being at ground level so that portable lengths of the rails for the general cargo cranes can be laid above them, crossing them of course at right angles.

These portable lengths are lifted for the heavy crane to pass forward when it is required at the quayface, being of course replaced for the general cranes to work along the quayface normally when the heavy crane is retracted. Of course, it is not every quay that could accommodate such an arrangement.

Types of heavy cranes are dealt with later.

Dimensions

It is a simpler matter to fix the crane dimensions at coastwise ports where the vessels to be dealt with are known ships, more or less the same day by day, than at large public docks which have to be prepared to deal with ships of any dimensions up to a maximum. In general in these latter cases dimensions of new cranes are determined on the basis of their being able to deal with the largest known ship the port is able to accommodate.

The rake of the jib is thus set so as to suit the ship of the largest beam likely to make use of the quay, the dimensions having to be sufficient to plumb the far side of the largest hatch when the ship is tied up. The actual rake must of course suffice not only to cover the outreach from the quayface but also the length the centre post is inside the quayface. Allowance also has to be made for plumbing the hold, as aforementioned, when the crane is set for the jib working into the hold at an angle as it will have to do with two cranes working into the same hatch.

The general radius of new P.L.A. cranes for the larger docks is 70-ft.; in some of the London Docks, in fact, cranes up to 100-ft. rake are in use. The radius of other authorities' cranes runs to 50-ft. to 70-ft. these figures being approached by similar cranes at railway and other coastwise ports.

The maximum number of cranes that normally can effectively be worked into a hatch is in the writer's view, two, and in general two cranes will suffice to keep the hold gang fully occupied, and will more than make up for the idle time of the cranes movements between the successive arrivals of a load, or *vice versa*, of the empty hook, in the hold. The hold gang have of course not only to detach and attach from and to the lifting hook, but have also to stow away and break out in the hold. In working two cranes to a hatch they will have to slew in opposite directions away from each other.

Under special arrangements and with cranes of a very long luffing range, three might be used to a hatch, but it is questionable whether anything much would be gained thereby as regards speed of loading or unloading.

It is important in either case that the cranes be of level-luffing type.

At the shore end with either or both cranes using the luffing movement, it would be possible for both to work to and from the same point but there are obvious advantages in avoidance of congestion and the like, in the two cranes working to independent points. There may be some advantage in their working from the same point for outwards cargo so as to keep together con-

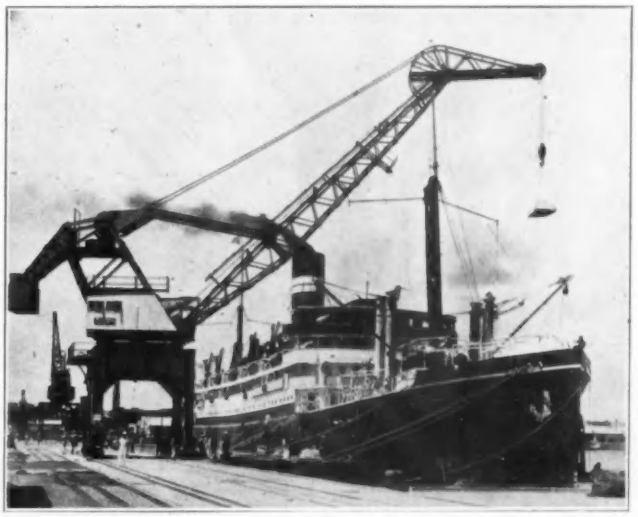


Fig. 5. 5-Ton Level Luffing Quay Crane, Messrs. Babcock & Wilcox.

signments having the same destination and having been brought to the quayside in the same wagon or set of wagons. There is less reason for incoming cargo being delivered to the same point as it should reach its proper wagon from whatever point it comes off the crane.

Centre-Post Location

The question of the distance of the centre post inside the quayface has already been referred to, it depends partly on the construction of the carriage and superstructure, including in especial the tail radius, and partly in special cases on the exigencies of the site. As regards the former, the circumference of the roller path on which the superstructure, jib, etc., of the crane rotates should lie at its outermost or seaward point within the vertical plane of the seaward travelling rail to be satisfying from a stability point of view, and the centre of gravity of rotating parts including the load should at all times fall within the roller path.

For a single track portal it is usual for the centre post to be at the centre of the undercarriage; where two or more tracks are covered, or the crane is semi portal, the centre post may be at a similar distance from the quayface to that of a single track portal crane or may be further back (with, of course, a correspondingly increased rake) dependent on the ground it is desired to cover.

The position of the seawards legs should be sufficiently far in from the quayface to give ample working room for men making their way along the quay with mooring or other ropes or with trucks and barrows. If battery or petrol driven trucks are to

Quayside Cranes at Ports—continued

be used along the quay this space should be at least 6-ft. and more if the crane rail is to stand above ground level, as the trucks should be able to pass each other. It is desirable that the rail should be kept clear of the ground from the point of view of keeping it unobstructed by debris, but this is rather a counsel of perfection and in any case creates some obstruction so that it is more usual for the rail top to be flush with the ground level of the quay. Where this is the case the crane and its track rail may be kept closer to the quayface even if power trucks are in use as they need not of course pass each other in front of the cranes.

Stability

The moving superstructure of the crane should carry counterbalance weights so as to keep the resultant centre of gravity of all the loads substantially within the roller path under all conditions of load up to full load. As already mentioned in the case of luffing cranes, there is a tail weight balancing the jib which in some designs forms part of it; in other cases it is separate and its radius from the centre post increases with that of the jib. This has the effect of keeping the crane from being back heavy on the roller path at short radii. For overloads additional counterbalance may be allowed for in the effect of the weight of the undercarriage being brought into play through the centre post; additional counter-balance weights may be provided and carried in the structure of the under-carriage at suitable points for this purpose. It is a frequent requirement that the crane must be stable with 100% overload dependent from the jib when extended at full rake seawards and must also be stable with 50% overload similarly hanging on the jib at either side.

It must be remembered that with electric cranes heavy overloads and severe stresses may be incurred when a lifting hook catches in the coamings of the hatches, and the more or less unlimited power exerted before the circuit breaker acts to cut power off must be borne in mind.

Height

Reverting to the question of height, the carriage of the crane is sometimes raised very high with the object of improving the crane-drivers view of the ship's hatches and giving a view into the ships hold.

The height of the jib head should, however, be minimised as far as possible in view of the tendency of long ropes to allow the load to swing unduly. From the operating point of view the height should be sufficient to allow the hook to come up far enough to enable the load to clear rigging and ships superstructure in slewing and luffing to a hatch and to allow sufficient overtravel above this point for the operation of automatic cut-off gear, stopping the lifting motor and applying the brake in time to prevent the lifting hook fouling the jib head pulley.

The cut-off gear will preferably be of the type operated by the position of the load directly in relation to the jib head. If as is sometimes the case it is operated from the working drum, in the case of luffing cranes cut-off may take place with the load well down from the jib head. This may be at the normally highest position specified to which it is required to lift the load, but it is nevertheless irritating for it to be desirable and apparently possible for the load to go higher and the crane nevertheless be unable to operate to make it do so.

View

The height of the carriage should allow of the jib being set at such an angle as not to foul bulky loads at the top of the lift; in some special cases the jib is swan-necked or of the so-called "Fairbairn" type for this purpose, but this adds to the weight, complication and cost of construction of the jib. The height should also be sufficient to ensure that the crane driver in his cabin stands as aforesaid well above the top-most hatch of the largest ship to be dealt with. It is however, impossible to ensure to the driver an adequate view into the hold of a large ship unless he be provided with a cabin carried near the end of the jib itself. The writer believes that this has been done in some cases, but does not consider the arrangement to be desirable, as there are many objections to it of exposure, deterioration of view in other directions, complication of control wiring, and the like, and even apart from these the object of the arrangement is liable to be defeated by the low grade illumination in the hold in contrast with the bright light from which the driver has to look down into it.

There is at least one type of control gear which operates the motions of the crane through a push button controller carried by the operator and connected to the main controllers through a flexible cable so that the operator can take up any position from which he can best view the work. This control has not been adopted very extensively; the push button controller though it only carries control current is heavy and the method of control precludes the use of mechanically operated or any brakes other than electrically operated ones while the arrangement as a whole adds considerably to the cost and complication of the control gear and wiring up of the crane.

It is a standard of practice to have a signalman looking down into the hold form the top hatch deck level and directing the crane driver and this would appear to be the soundest, safest and generally most practicable arrangement as well as that contributing to the fastest speed of working.

Alternative Cranes

An alternative crane is that in which the cross girders of the carriage carry rails to form a run-way for what is practically a self-contained traversing jib crane. The jib is generally fixed, but in some cases is fitted with luffing gear. This latter provides the same covering power in two ways, but as the use of the luffing motion obviates the necessity in the case of short distance movements for using either the traversing or the travelling motion or both, and is a quicker and more flexible movement, its embodiment may be justifiable. Both the traversing and more particularly the travelling motion require the movement of more weight —in the case of the travelling motion much more. These cranes are not in the writer's view efficient substitutes in ordinary quayside cargo work for the ordinary crane above described with the moving superstructure assembled round a fixed centre post. They are, however, useful where a large area of ground for stacking or other storage purposes has to be served, back from the quayface, necessitating a carriage much extended in the direction at right angles to the quay.

Such cranes fitted with grabs are used, for example, to serve ore and coal storage areas extended far back from the quayface.

The roller path diameter of this type of crane is necessarily somewhat restricted as compared with the more usual jib crane and the centre post has heavier duty. Also the tail weight must counterbalance all possible loads and overloads since there is no tie between the moving crab and the undercarriage.

A further alternative to the jib crane is of moveable transporter type having a projecting track at right angles to the quayface and jointed so that it can be triced up clear of the quayface when not in use. On this track, which in the case of light duty appliances may be formed of the bottom flange of an "H" iron, or in heavier cases is a straight built up runway, runs a crab with lifting gear carrying the load which can be picked up or lowered at any point underneath the track, which of course runs across the ship. Such an arrangement if it can be positioned satisfactorily so that the points of loading and delivery shorewards and over the ships hatches can, once set, continue to be in line with each other for a prolonged period, can work fast with a minimum of movement but any fore and aft movement requires movement of the crane as a whole and would be both slow, clumsy, and expensive in power. There may conceivably be appreciable difficulties with such a machine in clearing rigging and superstructure.

Heavy Cranes

Heavy cranes are mainly used at the quayside for dealing with exceptional heavy loads, for coal loading, and for grabbing work, the last mentioned duty in general requiring cranes of lower capacity than the two first mentioned.

The highest capacity crane put down normally as one of a group handling cargo at the quayside is of 10-tons capacity and

Quayside Cranes at Ports—continued

even a crane of this capacity working among others of 3-ton and 5-tons is not as a rule capable of doing equal duty with them and is also apt to cramp them to some extent, especially if it has to work into the same hatches, etc., as one or more of the lighter ones.

The alternative possibilities as regards the siting and operation of heavy capacity cranes for special loads have already been set out and it has been suggested that the isolation of the heavy crane and the movement of the ship to it, is in general the best course, but that where conditions permit, the heavy crane may be satisfactorily placed among the normal low capacity cranes along the quayside, as per the arrangement shown in Fig. 7. This is a Babcock and Wilcox 80-ton crane, the features of which affecting its sitting have been described earlier. It will be remembered that the crane tracks run to the quayface at right angles, and that they are fixed at a level such as to permit portable sections of the longitudinal tracks of the lighter general cargo cranes to be put down above them when, as is normal, the heavy crane is not required and stands back on its track away from the quayface and clear of the working radii of the lighter cranes.

This crane is of the heavy jib type fitted with Babcock and Wilcox level-luffing gear crank operated, both of which features are clearly shown in the illustration. It is of 80-tons capacity with a radius of 62-ft. 6-in. and an auxiliary lift of 20-tons at a radius of 72-ft. 6-in. It runs on 16 wheels, 8 of which are driven.

The hoisting speed is 5-ft. 9-in. per minute there being a change speed gear increasing the speed to 11-ft. 6-in. per minute with a load of 40-tons.

Overload protection prevents loads above 80-tons being lifted and also prevents the jib from being luffed out beyond 62-ft. 6-in. with 80-tons on the hook.

There is a change speed gear also on the auxiliary hoist which is independently driven.

The current supply is D.C. at 550v. supplied through flexible trailing cables and plugs; braking on both hoists is dynamic.

The crane luffs with 80-tons at 60-ft. per minute.

Another form of heavy load crane is the Titan or Hammer Head. This is a useful but somewhat expensive type covering a large area with the comparatively simple motions of traversing and slewing; its construction is that of a cantilever set of main girders, counterbalanced on the opposite side of the centre post, carrying a traverser crab and supported from and slewing round a central pillar and roller path on a built up carriage which may travel but is more often fixed.

The crab generally carries a light load and a heavy load lifting barrel each independently driven and in some cases there may be three barrels. Such cranes used for block setting in quay wall and breakwater building, comparatively low set, with a very long rake, are generally known as Titans. The same type of crane then known as a Hammer Head is used for shipbuilding and repairing work, in which case it is set up on a very high carriage, has a somewhat less rake than the Titan, but is of very heavy capacity—up to 150-tons or more. These latter have been suggested also for dealing with heavy load cargo lifts, but the writer does not know of any cases in this country where they have actually been adopted for such a purpose, and they would not appear to lend themselves to erection among the normal cranes along the quay unless of very long rake, so that they could be sited well back and set very high, to both of which there are objections.

The heavy load appliance in use at many docks is the Sheer Legs. This consists of two front legs pivotted near the quayface, in an approximately vertical inverted "V," with a third leg between the two and pinned to the apex of the "V,"where also are carried the top sheaves of the lifting block. This third leg comes back landwards at an acute angle to the two front legs in the vertical plane, to a travelling block generally screw operated. Movement of this block causes the forward legs to swing through an arc in the vertical plane sufficient to move the load from the quay to the deck of a ship. This travelling movement athwartships and the lifting movement are the only motions embodied in this type of appliance. Any fore and aft adjustment for positioning the load on a ship has to be got by movement of the ship itself. While this appliance is a somewhat crude one, it is simple and notwithstanding the heavy foundation work it requires, it is cheap in relation to the duty it has to deal with.

A variation of the construction described is the building up of the two front legs as the forward portion of a structure triangular in a plane at right angles to the quay face; the swinging movement is then operated by arms, screw geared into blocks on the landward end of the base of the respective triangular structures, a projection from which generally also carries a counterbalance weight.

Fig. 6. 3 and 5-ton Quay Cranes, Messrs. Cowans, Sheldon & Co.

Coaling Cranes

Coal loading cranes are in general 40 to 50-tons capacity and where they are intended to deal with 20-ton wagons they should not be of much less than the latter capacity if they are to have a sufficient margin over their normal working load.

The practice is with them to lift the wagon to be emptied bodily on a cradle which lies on the rail track, being either sunk so as to form part of the rail track, or arranged with its rails above the track level, the wagon being run up on ramps. The latter arrangement requires more capstan work and some additional labour.

The wagon must be end door type and the end door must be the right way round, so that either a turntable must be provided or the cradle must be capable of being turned round so as to bring the wagon end for end, and must accordingly be itself symmetrical end for end. There are in the latter case some complications in the attachment of the lifting ropes, and the turntable is the more usual arrangement being capstaned round when the wagon requires turning.

In the older type of such cranes, after lifting to a suitable height the wagon is slewed over the hold, lowered as necessary—theoretically down to the point where discharge will take place at the level of the coal already loaded, (always provided that the hatch

Quayside Cranes at Ports—continued

will take it), and then at this selected point the cradle and wagon are held up at the solid end of the wagon and tipped by continuing to lower the end with the door; the pin holding the door closed is then pulled out and the coal released into the hold. In modern cranes tipping is effected by lifting the solid end of the wagon after lowering down to coal level, there being two separate sets of ropes of two ropes each. In the older cranes tipping was arranged for by chains attached to the jib head, of fixed length, as from wagon to wagon, but capable of being linked up to adjust their length and the height at which tipping took place according to the depth of hold of different ships, state of loading, tide, etc.; these chains held up the fixed end of the wagon when it was lowered to the full extent of their length.

In modern cranes there are in general two lifting and two tipping ropes, the two sets of ropes being in many cases worked independently from separate winding drums each driven by its own motor.

Fig. 7. 80-ton Crane lifting electric trolleybus at Port Natal. Messrs. Babcock & Wilcox.

The two motors share the load in hoisting and in lowering bodily, the tipping motor operating alone to lift the solid end of the wagon after the tipping position is reached, and the hoisting motor holding the wagon in its position theoretically close down on the coal already tipped.

The speed of hoisting and tipping is high having regard to the weight of the lift and these motors run up to 250 h.p. or over each. Generally they are supplied through motor generators on the Ward-Leonard system and are not series wound. Some form of inter-connection is therefore necessary to ensure they share the load equally and more especially at the same speed of lift, otherwise the wagon might be tipped prematurely while hoisting or lowering was taking place.

The arrangement of independent winding drums separately driven and controlled is very satisfactory being free from complication in mechanical construction, fast working, easy of operation and requiring little maintenance attention.

There are however, variations from it which are preferred by some crane makers, also some users. The wagon may for example be lifted by one motor operating two drums each of which, or the non-tipping drum only may be coupled to the motor through a friction clutch, the holding drum being declutched and braked when the tipping point is reached.

Another method in considerable and important use is to double the ropes through sheaves, one end of the tipping rope being wound on and anchored to an extension to the main hoisting barrel, the other end passing round and being anchored to the tipping drum. In hoisting and lowering, the main hoisting motor thus takes the whole weight of the lift without the tipping motor being run, tipping of course being effected after the stoppage and braking of the main hoist on its end of the tipping rope.

In some ways the latter scheme is the most attractive of the various alternatives and to a great extent it shares the advantages of the independent barrel drive and should be equally fast, but the main hoist motor must be much larger.

There is some slight preference in the way of reducing the fall and breakage of the coal in tipping by lifting the solid end of the wagon than by lowering the door end; in the latter case obviously some of the coal is liable to fall before the door end of the wagon has reached the level of the coal already tipped.

In many cases of small coasting vessels, however, the hatches will not allow of the passage through them of a wagon, consequently the coal must have a heavy fall unavoidably, and at commencement of loading to the extent of the full depth of the hold.

Coaling cranes should be capable of handling wagons up to 20-tons capacity; if so, allowing for the weight of the wagon itself and the cradle, to be as they should be well on the right side, they should be of 50-tons normal lifting capacity and at a speed of 40 to 60-ft. per minute require 200 to 300 h.p.

So far as the writer is aware no such heavily powered cranes other than for electric operation have been put into use in this country; in the case of most if not all of those installed, for electric operation special methods of supply to the motors have been adopted to provide for smooth acceleration, facility of control, and minimisation of control gear maintenance together with easing of demand on supply mains.

These special means as aforesaid take the form of motor generators on the Ward-Leonard system in which with three-phase supply an A.C. motor drives a D.C. variable voltage generator, starting and speed control being effected thus by varying the supply voltage to the motor or motors.

The motions other than lifting may be similarly controlled, may be worked D.C. at non-variable pressure, or may be A.C. operated. As already indicated the writer would consider it possible to make use of grid controlled variable voltage rectifiers for such cranes, but so far as he is aware no such arrangement has yet been tried.

Theoretically the use of cranes of this type for coaling should reduce breakage of coal in loading to a minimum as, where the hatches are large enough, the wagon can be lowered down to a point where the fall is almost nil. In practice if a reasonable rate of loading is to be attained, at all commensurate with the commercial value of the quay and berthing space occupied, this theoretical ideal can never be attained. Even at its best the coaling crane cannot attain anything like the rate of loading of a conveyor or of the familiar hydraulic coaling hoist which so far as speed is concerned is an exceedingly efficient machine; also it is incomparably unhandy in comparison with the conveyor in dealing with difficult and small hatches and in bunkering, and according to the writer's experience of tests with which he has been connected, its results as regards breakage, if perhaps somewhat better than those of coal hoists even with anti-breakers, are at least no better than those given by conveyors fitted with anti-breakers even in the present early and imperfectly developed stages of the latter.

(To be continued)

Review

Regional Planning: An Outline of the scientific data relating to Planning in Great Britain, by L. B. Escritt. Pp. 263, with maps, diagrams and folding plates. Price, 12s. 6d. net. London, 1943: Messrs. George Allen & Unwin, Ltd.

So much attention is being paid nowadays to the subject of Planning for City, Urban and Rural Development, that Mr. Escritt has been prompted to prepare a work of reference for planners and others engaged in design, in order to provide them with a general conspectus, or outline, of the whole subject. The author states that his " prime intention is to demonstrate the vastness of the field of study, to show the inter-relation of natural phenomena and practical sciences, to stress the necessity of their being understood by those who would make themselves fit to co-ordinate the activities of various members of a planning team, and to suggest a means by which knowledge and understanding may be gained." It must be felt that the aim is an ambitious one, almost sufficient to tax the capacity and versatility of any author.

The volume comprises five sections, dealing respectively with Scientific Planning; The Earth and its Products; the Water Cycle; The Town, and Transport. Lacking the encyclopædic knowledge requisite to deal with so wide a field, we must confine our attention to a sub-division of the last-named section, which lies within the immediate purview of this Journal.

Chapter xiv is devoted to Ports. Within the space of ten pages, the author contrives to give a brief, but serviceable, resumè of their principal functions. He discusses the question of " siting " (we confess that we dislike this word: " location " is much to be preferred) and points out that in this country there is only a limited number of possible sites for first-class ports, practically all of which are now utilised. Perhaps he might have added that an excellent site is no guarantee of successful exploitation, since trade is a fickle jade and distributes her favours very erratically. She is not always wooed with success

The author rightly says that a port cannot be operated efficiently without adequate facilities and points out that the burden of providing these generally lies with the Port authority, though it is an unfortunate fact that, in some cases where adequate facilities and appliances are provided, they have not been utilised to their full extent and, indeed, the financial return is often unremunerative.

The author also calls attention to the importance of the hinterland of the port and to the desirability, wherever possible, of developing industrially those areas which lie in the immediate vicinity of ports. The need for this is becoming increasingly recognised and various ports have adopted schemes for the lay-out of industrial areas adjacent to port premises. This has notably been the case at Manchester and Bristol in this country, and at Venice, Rotterdam and other centres abroad. There is no doubt that in considering the question of planning, this feature of port alimentation should receive full consideration.

The remarks on ports are necessarily compressed so that little more can be said in regard thereto, but taken in conjunction with the wide survey of the whole field of planning, we feel that the author has succeeded in producing an eminently useful and concise manual which should be read by all who are engaged in schemes of civic development. He quotes a number of authorities on the various branches of the subject and shows a considerable range of reading and research.

The volume has a useful bibliography, listing nearly 300 works of reference and there is a serviceable index. Having regard to war-time conditions, the production is highly creditable, with a neat and attractive binding.

Dock and Wharf Companies' Finance.

The Manchester Dock and Warehouse Extension Company, Ltd., are paying a final dividend of 1½ per cent. on the Ordinary Shares making a total distribution of 2½ per cent. (less tax) for the financial year ended 24th June. At the annual general meeting of the Associated Coal and Wharf Companies, Ltd., on the 23rd August, a final dividend for the year ended 31st March of 4½ per cent. (actual) was passed, making 7½ per cent. for the year.

Port of New York Authority

Features of Annual Report

In their annual report for the administrative year ended 1st April, 1943, transmitted to the Governors and Legislatures of the States of New York and New Jersey, the Commissioners of the Port of New York Authority review the important developments which have taken place in the preceding twelve months and stress the importance of foreign trade to port economy.

The report points out that one in every ten persons in the metropolitan area is directly or indirectly dependent upon the port for a livelihood and that the New York and New Jersey sections of the port jointly represent a " plant investment of several billion dollars." (In America a billion is a thousand million—not a million million as in England).

There are stated to be three specific threats to the commerce of the port.

" First, the Port of New York must meet the challenge of the revolution in transportation which has been accelerated by the war; second, extraordinary measures will be necessary to regain the commerce which war directed to other port areas; third, the danger of burdensome terminal and local transport costs must be attacked with a new vigour and decisiveness."

The great war-time increase in the use of airplanes for both cargo and passenger traffic calls forth the comment that " we do not subscribe to the school which holds that the bulk of commerce will one day cease to move by ship, rail or truck. Yet we do believe that air transport will compete for an important volume of high grade freight and passenger traffic and that the Port of New York must plan now for the development of those facilities and the acquisition of those services which will make the port the crossroads of the world's air lanes, as well as the nation's principal gateway for water-borne commerce."

The report points out that the year's activities have been limited by a decline in revenue, combined with a stringent programme of financial retrenchment. There was a fall of $2,528,994 in operating receipts.

Among projects discussed, as constituting features of early post-war construction, are a series of union motor truck terminals, a union produce terminal and a union marine grain elevator. The necessity for unification of railroad harbour operations is also urged.

Publication Received

A booklet entitled **Industrial Rubber Products Conservation** has been issued and circulated by the Goodyear Tyre and Rubber Co. (Great Britain) Ltd., of Wolverhampton, with the object of conserving rubber products in this country and, at the same time, of obtaining the maximum service from these products. It deals with various forms of wear and wastage in installations of rubber belts in conveyors, elevators and service drives. The information it gives is of practical value, and deserves the careful attention of all users of such appliances. Copies of the booklet are stated to be available for free distribution to interested users of industrial rubber productions.

Port Health Authorities and Ship-boarding Facilities.

Owing to accidents which have arisen from lack of proper and secure means for boarding ships by sanitary officers at the Port of Blyth, the Health Authority of the Port has recently reaffirmed its decision that ship boarding by their officers should not be attempted until safe means have been provided and the authority's officers have been warned accordingly. It is not uncommon experience for boarding to be carried out under risky conditions and the consequences of an accident due to such a course is in future to be regarded as having occurred outside the employment of the officer concerned, and therefore not the responsibility of the Port Health Authority. Apparently, there is difficulty in tracing any regulations under which the authority can demand from ships and shipowners the necessary safe facilities.

Movable Bridges across Port Waterways

*Development of the Chicago Type Bascule Bridge**

By DONALD N. BECKER,[1] M.Am.Soc.C.E.

SYNOPSIS.

On the background of a description of the waterway system that serves the navigation needs of Chicago, Ill., the author describes the development of a bridge type that serves the peculiar local requirements. The evolution of the movable type of bridge is traced through several phases, including the early "jack-knife," the vertical lift, the rolling lift, and, finally, the various developments of the bascule type.

Introduction

THE Chicago River (see Fig. 1) lies along the north side of the central business district, branching just west of it, with the North Branch traversing the north side of the city in a more or less northwesterly direction and the south branch traversing the south side in a southwesterly direction. In the extreme south end of the city is the Calumet River system. In Fig. 1, the various bridges mentioned herein are given numbers that are identified as follows: 1. West Cortland Street (Clybourn Place); 2. West Division Street (River); 3. West North Avenue; 4. North Halsted Street (Canal); 5. West Kinzie Street; 6. West Washington Street; 7. West Grand Avenue (Indiana Street); 8. East 92nd. Street; 9. West 35th. Street; 10. West Chicago Avenue; 11. West Webster Avenue; 12. West Belmont Avenue; 13. West Monroe Street; 14. North Franklin-Orleans Street; 15. West Adams Street; 16. East 106th. Street; 17. West Roosevelt Road (Twelfth Street); 18. North Damen Avenue (North Robey Street); 19. South Damen Avenue (South Robey Street); 20. North Wabash Avenue; 21. West Ogden Avenue (Canal); 22. West Ogden Avenue (River); 23. Outer Drive (River); 24. Outer Drive (Canal); 25. South Ashland Avenue; 26. North State Street; 27. Weed Street Crossing of Chicago River; 28. Canal Street Crossing of Chicago River; 29. South Halsted Crossing of Chicago River; 30. Van Buren Street Bridge; 31. Metropolitan Elevated Railroad Bridge; 32. North Halsted Street crossing of North Branch; 33. La Salle Street Tunnel; 34. Washington Street Tunnel; 35. Clark Street Bridge; 36. Wells Street Bridge; 37. East 95th. Street and Calumet River; 38. West Division Street and North Branch Canal; 39. Cortland Street and North Branch; 40. North Western Avenue and North Branch; 41. West Archer Avenue and South Fork of South Branch; 42. West Erie Street and North Branch; 43. West Lake Street; 44. Lake Street Elevated Railway; 45. West Lake Street and Elevated Railway; 46. Dearborn Street Subway System; 47. Northwestern Elevated Railway; 48. Michigan Avenue; 49. West Jackson Boulevard and South Branch; 50. East 100th. Street and Calumet River; 51. Madison Street; and 52. South Torrence Avenue and Calumet River.

Before civilization reached Chicago these rivers were relatively shallow streams, navigable only in the sense that canoes and shallow draft vessels could enter them from Lake Michigan. With the development of the city, both of these rivers were deepened and widened so that they are navigable for considerable distances for the largest lake-going vessels. They are generally equipped with dockwalls providing channels varying in width from 100-ft. to 250-ft.

When the early settlers travelling overland first reached the Chicago River, they established ferries, but these soon proved inadequate for the traffic, and as early as 1833 a crude float bridge, manipulated by cables, was installed. In 1834, a wooden draw-bridge similar to a double moat-bridge was built across the river, only to be torn down five years later because it was an obstruction to navigation.

By 1840, however, the land traffic was so heavy that another bridge was built over the river. This time it was a pontoon type that could be pulled open when needed for river traffic. Several of this type were built in the next few years. In 1854, the first pivot swing bridge with wooden trusses was built across the river; and in 1856 the first all-iron bridge was built. By the time of the great Chicago fire (1871), there were twenty-seven movable bridges costing well over a half million dollars. The great fire destroyed eight of these. By 1890, the number of bridges had increased to forty eight, some through the annexation of adjacent towns to the city.

During this period many disadvantages of the swing-type bridge presented themselves, so that thought was directed to the new types that were being developed in the minds of embryo inventors. In 1890 a so-called "jackknife" bridge, built under patents issued to Capt. W. Harmon, was installed at Weed Street, the action of each half of the bridge resembling that of a loosely-hinged jackknife as it lowered from the vertical position. It was expected that, if experience showed that this type of bridge could be operated safely and economically, it would be preferable in most cases to the swing bridge. It was also thought that the raised floor, in the open position, would solve the street barrier problem.

In 1892 so much objection was raised to the swing bridge, built only two years previously at Canal Street at a bend in the river, that it was ordered to be removed and was replaced at a cost of $46,844.90 with a Harmon-type of jackknife bridge (Fig. 2) providing an 80-ft. draw. From the beginning it was troublesome due to light construction and poor execution.

In 1892 when it became necessary to replace the old swing bridge at South Halsted Street, the navigation interests and the Drainage Board (later The Sanitary District of Chicago) objected so effectively that the War Department refused to issue a permit for a swing bridge. After considering the Harmon jackknife and the Waddell lift bridge, the city decided in favour of the latter, which was completed and opened to traffic on March 22, 1894 (see Fig. 3). It consisted of a steel truss span, 130-ft. long by 58-ft. wide, with a single roadway 40-ft. wide and two sidewalks 8-ft. wide. Its weight (280 tons) was lifted vertically between two towers that were braced by a truss between the top of the towers at a height of 155-ft. above the river level. The lift span was suspended by wire ropes that passed over sheaves at the tops of the towers and were connected to cast-iron counterweights within the towers. The bridge was operated by steam hoisting machinery located on top of the lift span at its centre, which operated cables attached to the tops and bottoms of the towers. The total cost of the bridge was $242,880.

In 1894, when it was necessary to replace the Van Buren Street bridge, and the Metropolitan Elevated Railroad Company wished to build a bridge across the river a short distance north of it, conditions being such as to prohibit the use of swing bridges, a new type was adopted (see Fig. 4) for both locations. This bridge was hailed as the embodiment of an eleventh century idea brought up to date, as the combination of the bascule (which was the most common type of medieval moat bridge) and the latest electric and pneumatic appliances. It was equipped with air brakes and two 50 h.p. electric motors on each leaf. It cost $169,700.

In 1895 this gave the city three highly different types of bridges for comparison, the Harmon "jackknife," the Waddell "vertical lift," and the Scherzer "rolling lift." In 1896 a second Scherzer bridge was built at North Halsted Street over the North Branch.

*Reproduced from the Journal of the American Society of Civil Engineers, February, 1943.

[1]Engineer of Bridge Design, Dept. of Public Works, City of Chicago, Chicago, Ill.

Movable Bridges across Port Waterways—continued

From the Annual Report of the Department of Public Works of the City of Chicago for 1898 the following is quoted to indicate the conditions then:

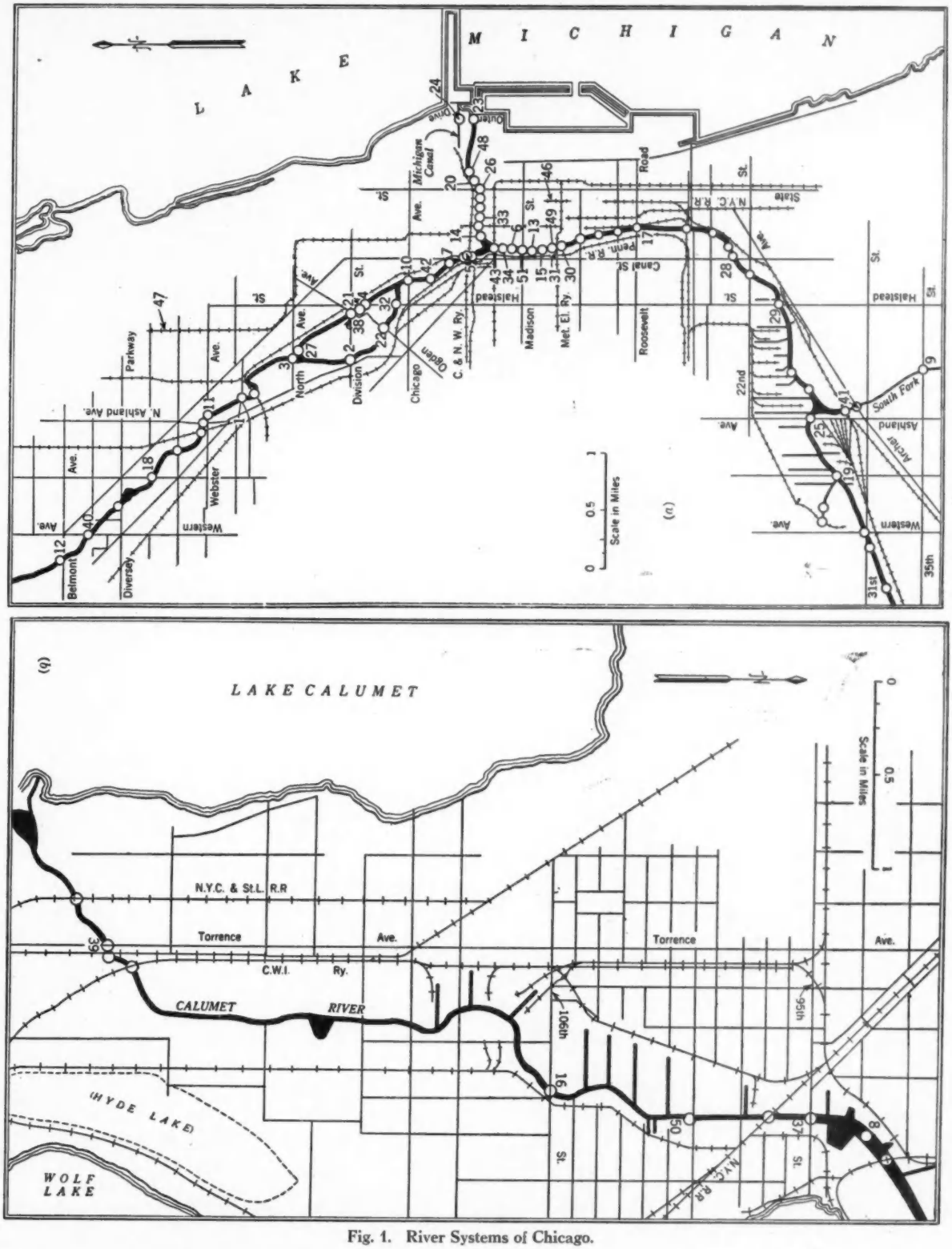


Fig. 1. River Systems of Chicago.

"There is no portion of the City's service that is in such need of immediate attention as the bridges and viaducts of the City, and it is to be regretted that appropriations of sufficient amount cannot be secured to make proper and necessary repairs. Many of the structures are old and dilapidated and have reached that stage of decay where wise expenditure of money cannot be made to repair them, and they should be replaced by new structures.

Movable Bridges across Port Waterways—continued

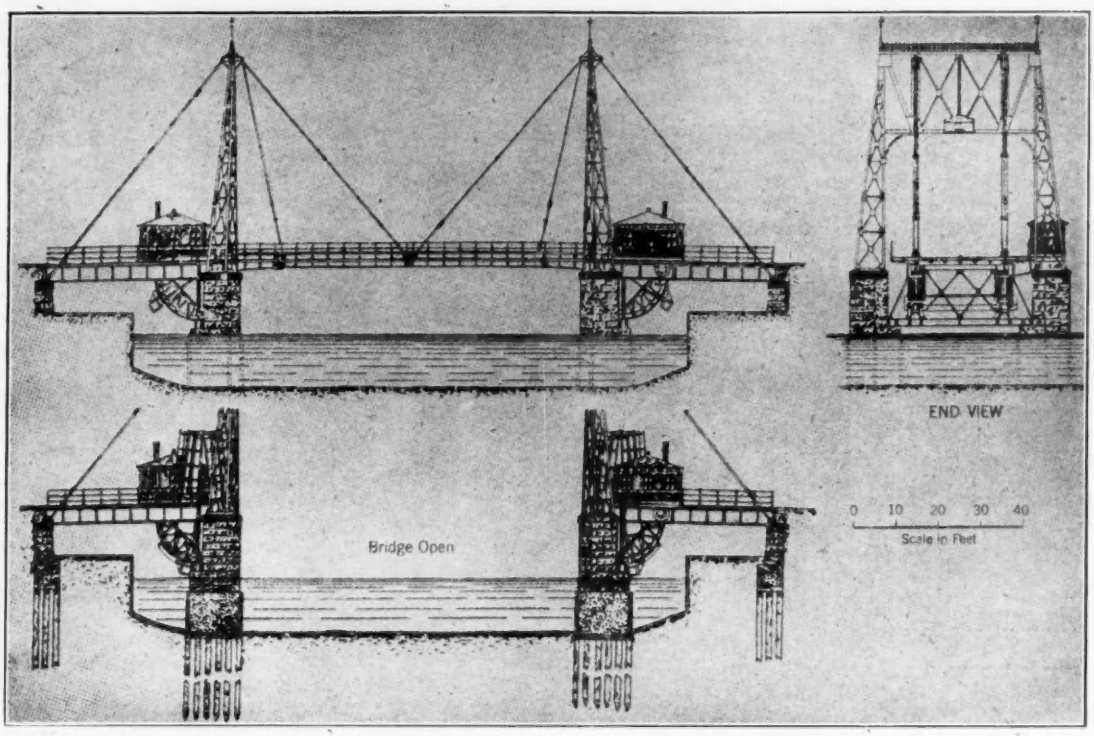


Fig. 2. South Canal Street Folding Bridge over the South Branch of the Chicago River, 1892.

All the bridges to be constructed hereafter should be constructed on such a plan that centre piers will not be necessary. The practice of placing obstructions of any character in the Chicago River should be discontinued, with a view to accommodate navigation and to conform to the policy of the statutes governing the construction of the Sanitary Drainage Canal. While the importance of the Chicago River appears to be appreciated by the citizens in the discussion of the development of Chicago, no practical steps have been taken by the City to preserve it as a harbour for modern vessels. A reference to the tables submitted by the City Enginer in his report must convince anyone that the greater facilities offered in the Calumet River are diverting a large portion of the business from the Chicago River, and while the Calumet interest should be conserved and promoted as a Chicago interest, due consideration should be given to the Chicago River in our plan for future development of Chicago."

Fig. 3. South Halsted Street Bridge, facing North-east across the Chicago River, 1894.

Navigation in the Chicago River was hampered by artificial restrictions, such as centre piers of swing bridges, protruding dockwalls where the owners had thought no further than how much land they could create for their own use, and lastly by the shallow clearance over La Salle Street and Washington Street tunnels where only 17-ft. of water was available. The largest vessels plying the Great Lakes were 432-ft. long by 48-ft. beam, with a draft of about 16-ft.; but due to the tortous channel in the river they could not enter the Chicago River farther than the Clark Street bridge. To proceed further it would be necessary to enter the north draw at Clark Street, then head diagonally across the river toward the south draw at Wells Street so as to cross over the La Salle Street tunnel at the middle of the river, which was the only point deep enough to permit passage. If the vessel did squeeze through in this manner it could not enter the North or South Branch due to centre obstructions and bends in the dockwalls.

The law creating the Sanitary District provided for a canal with a discharge capacity of 10,000-cu. ft. per sec. The District embarked on a policy of constructing a 200-ft. channel in the South Branch with a centre depth of 26-ft. and a cross section of 4,800-sq. ft. so as to limit the current to about $1\frac{1}{4}$ miles per hr. Property was condemned and the docks were moved back. As the city was in no position to replace bridges to accommodate this increased flow, especially where bridges were in fair to good condition, an agreement was made whereby the District would rebuild certain structures and turn them over to the city. Under this arrangement ten bridges were completed between 1902 and 1907; nine of these were of the Scherzer rolling lift type, and one of the Page type.

Between 1896 and 1900 the city finances were in such a state that not only was no money available for new bridges, but even repair funds were greatly curtailed.

Movable Bridges across Port Waterways—continued

Fig. 4. Scherzer Type of Rolling Lift Bridge (1894) across the Chicago River at West Van Buren Street.

Birth of the Chicago Type Bascule

In 1900 the situation became so acute that $1,250,000 was authorized for eight bridges, $850,000 to be available in 1900. The next problem was to determine the type of structure. The first Harmon bridge at Weed Street was continually out of order, due to the number of joints, and was expensive to maintain. This was true also of the Canal Street bridge.

The vertical lift bridge at South Halsted Street, in spite of its high cost was proving quite costly in operation and maintenance each year. The rolling lift bridge, although admittedly more satisfactory than the folding jackknife and the vertical lift bridge, had the very important disadvantage that the centre of gravity travelled back and forth as the bridge opened and closed, thus requiring a solid foundation.

In 1899 the city's Bridge Division made a critical analysis of the literature on movable bridges in the United States and Europe, with a view to selecting a type of bridge most suitable to the Chicago River and its branches. The results were put in the form of a report giving the advantages and disadvantages of the various movable types in use. The type known as the trunnion bascule was considered to be the one that could meet Chicago requirements most fully and satisfactorily.

Three designs were prepared by the city, differing in appearance, method of mounting, etc., but all involving the principle of revolving on a fixed trunnion. The three designs were then submitted to a Board of Consulting Engineers, consisting of E. L. Cooley, the late Ralph Modjeski, M. Am. Soc. C. E., and the late Byron B. Carter. The Board selected and recommended the design designated as No. 3 with some modifications.

The design was described in the 1900 report of the Department of Public Works as a fixed-centre, double-leaf, counterbalanced bascule bridge. Each leaf had three through trusses operated by racks on their curved tail ends, the tail ends descending into a pocket or tail pit in the abutments when the bridge was open. The total width of the structure was 60-ft. the trusses being 21-ft. centre to centre, and the sidewalks being carried by 9-ft. cantilever brackets. The pivot bearings were 4-ft. back from the centre lines of the river piers and were carried by box girders spanning the tail pits in the abutments. The approaches were carred by I-beams, supported by cross girders resting on the box girders and extending from the river piers to concrete abutments independent of the abutments of the moving span. The bridge was designed to turn through a maximum angle of 76° 58′, which required a travel of 35-ft. on the patch line of the rack. The break in the roadway was on the river side of the pivot.

The machinery for operating each leaf was under the approach roadway, each leaf being operated by means of a pinion gearing with a rack on the curved tail end of each truss. The teeth on this rack had openings between them, preventing the clogging of the rack by dirt or ice. The teeth of the operating pinion dislodged any accumulation that would then fall through the rack. Along the top of the abutment a shaft carried three pinions and had two sets of driving gear, each set of driving gear being driven by an electric motor of 38 h.p. On each motor- driven shaft was a wheel for a band brake, operated from the bridge house by a vertical hand lever with a latch handle. Besides these hand brakes there was a worm-resistance brake at the middle of the rack pinion shaft and a hand-brake wheel was fastened to the shafts of the worm. To prevent resistance or friction in the worm brake when not needed, the worm was revolved by a light continuous hemp rope that passed over grooved pulleys on the motor-driven shafts and the worm shaft. The band brake was applied to the worm shaft to introduce the resistance, thus checking the motion of the worm and consequently of the gearing by which it was connected to the main shaft.

The machinery was designed so that the opening of the bridge, from the moment it was closed to traffic to the moment when the leaves reached their highest position, would not require more than 1-min. in calm weather or 2½-min. with a 70-mile wind blowing in a direction unfavourable to the operation of the bridge. Pneumatic buffers arrested the motion of the leaf at each end of its travel.

When the bridge was closed, the centre of gravity of each leaf was on the river side of the pivot, and as the movable part of the roadway did not extend back of the pivot it was only necessary to lock the leaf against further downward movement. This was done in connection with the bridge-closing buffers, by allowing the leaf to pull the lower buffer pistons against the cylinder ends, the cyclinders being anchored to the masonry.

When the bridge was closed, the action of the buffer was as follows: As the leaf approached the end of its closing movement, a hooked lug at the lower end of the arched back of each truss picked up a 6½-in. pin, connected by eyebars to a combined cross head and piston. This pin forced the piston upward in an inverted cylinder, meeting the increasing resistance of the compressing air, which absorbed the energy of the closing leaf. When the pressure reached 350-lb. per sq. in., the air escaped through a relief valve and allowed the piston to rest against the cylinder head above it.

As the leaf began to open, a second lug near the aforementioned hooked lug returned the buffer and connections, by means of a hooked lever, to position in readiness for closing.

The action of the upper buffer in arresting the leaf at the end of the opening movement was similar to that of the lower buffer, the difference being that the upper buffer was operated through an intermediate lever pivoted to special pairs of stringers of the approach roadway, which stringers also supported the upper buffer cylinders. The rear end of the lever acted on the piston through a short link. The front end of the lever was operated in essentially the same manner as the pin of the lower buffer, by lugs in the upper end of the arched back of each truss.

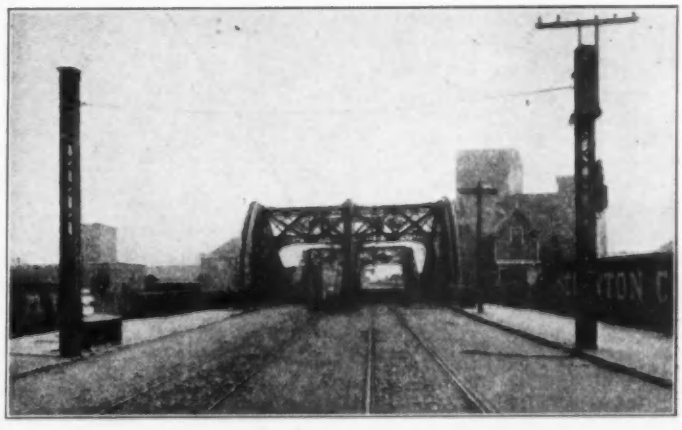


Fig. 5. West Clybourn Place Bridge (1902).

Movable Bridges across Port Waterways—continued

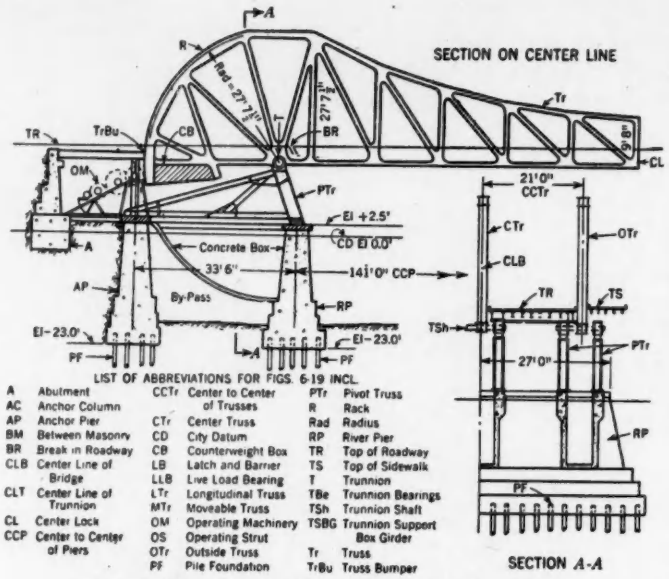


Fig. 6. West Division Street Canal Crossing (1903).

Quoting from the Report of the Board of Consultants:

"The principle of the trunnion bearing meets with our approval as a very simple solution of the problem, the chief advantages being the constant point and direction of application of the load on the foundation, whether the bridge is in motion or stationary, and the reduction of the number of moving parts to the minimum. The first advantage is of no great consequence if the piers are placed on an unyielding foundation, but with such foundations as can be obtained in Chicago at the majority of bridge sites, it is of great importance. The trunnion type of bridge used in these designs is an old and tried device, and is not covered by patents."

The consulting engineers called attention to the fact that the bascule design permits the centre of gravity of the moving bridge to be placed in or near the trunnion axis. Placing the centre of gravity a short distance from the axis of the trunnion toward the draw opening and the arrangement by which the fixed floor relieves the tail end from any possible live load, had the advantage of tending to hold the bascule firmly in position when closed, and so avoided the absolute necessity for heel locks. There was no tilting effect when a live load came on to the bridge.

The Board recommended a three-truss design, as had been prepared by the city, in preference to a two-truss design for the same width of floor, that the curved bottom lateral struts be omitted and a stiff lateral system used. Also, it was recommended that, when the bridge was raised, the floor beams be supported by angles running from the middle of each floor beam to the intersection of the lateral angles, and that the heel ends of the trusses be connected by a transverse brace, to add lateral stiffness to the racks and the counterweights.

The Consulting Board further recommended that adjustable resting blocks be placed in front of, and near, the trunnions so that when the draw was being closed, the load could be transferred from the trunnions to the resting blocks. This facilitated the lubrication and practically eliminated the starting friction of the trunnions. To meet all possble conditions of wind and incidental changes in the position of the centre of gravity, pawls or heel locks were used with the resting blocks. They were capable of lifting the tail ends and holding them firmly against the anchorage. This arrangement was also claimed to facilitate the overhauling and adjustment of the trunnion bearings.

Air buffers were considered practical, provided they could be designed so that the pistons would not withdraw from the cylinders, and provided they were packed with cupped leather or other material, to prevent entrance of foreign matter or grit into the cylinders. Air was controlled in the cylinders by free entrance through check valves, and by allowing exit through adjustable openings, for buffing. Springs insured proper action of the pistons. Exceedingly strong racks on the heel of the draw, with through openings between the rack cogs, met with approval as they will not accumulate ice in cold weather. On those rare occasions when sleet may coat the racks with ice, it was considered that the shaft and pinions were strong enough to force the ice through the cog openings.

There was no practical difficulty in making the driving machinery strong enough to resist all probable strains, and, therefore the engineers recommended the following general arrangement: The three pinions are mounted on one line of shafting, with specially strong bearings, being driven by two gears; these two gears are connected by a jackshaft and suitable pinions, with two gears mounted, and clutch-driven, on this jackshaft. The jackshaft gears are driven by two independent gearing trains to two motors. All these gears, shafts, and motors are arranged in a vertical or inclined train, so proportioned that all gears are between their respective shaft bearings, which were to have ample length and all were to be mounted, as far as possible, on one structure. The gearing could easily be made stronger and safer and more accessible for overhauling and repairs than that of any bridge then built in the city.

The worm-gear brake for emergency use had novel merits compared with the usual band brake on the motor shaft. If designed with large pitch and large angle of worm, running in an oil bath, the friction of the gears running light may not be large. By the ingenious application of a light rope belt (to revolve the worm), the friction due to the thrust of the worm was practically eliminated until the brake was applied. In the detail design, the desirability of friction brakes applied directly to the curved segments of the trusses can be developed. Finally, quoting the Report:

"It is fair to state that the assumed wind loads against opening or closing the bridge may never prevail in the practical handling of the bridge, and may be regarded as so much additional security. The fact is that ships do not navigate when such winds prevail, and there would be no occasion to open the draw at such times. In the case of the Tower Bridge (London), the reserve power put in on account of extra wind loads was reported as 'never used' at the end of two years.

"In general, our board is of the opinion that the flow of the river should be provided in the opening of the draw wherever practicable."

In the light of forty years of experience, the recommendations of this Board were almost prophetic, as so many of their recommendations have been adopted with the passage of years.

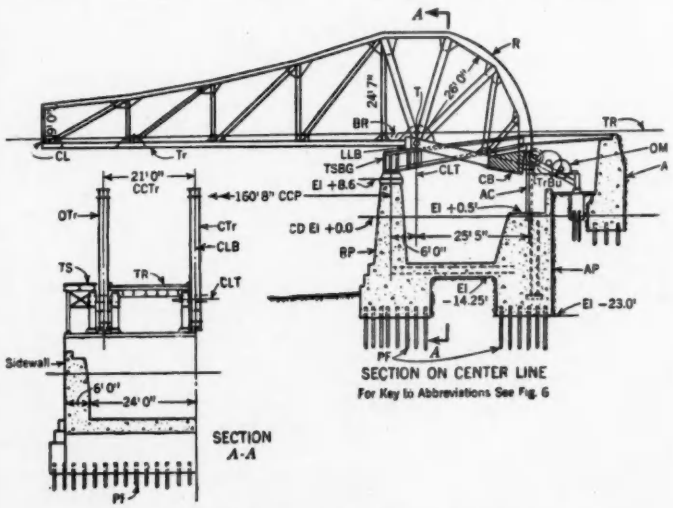


Fig. 7. West Division Street River Crossing (1904).

Movable Bridges over Port Waterways—continued

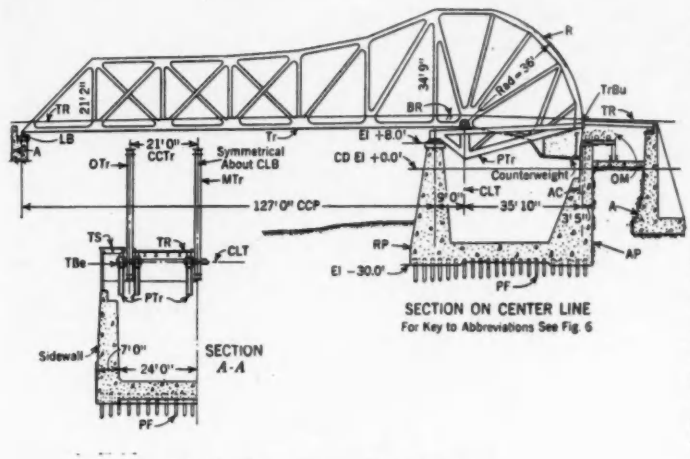


Fig. 8. West Kinzie Street (1909).

Early Examples of the Chicago Type

Meanwhile, the 95th Street swing bridge, over the Calumet River, had collapsed on August 17, 1899. This location was used as the site for a new bridge, the call for competitive bids to be opened on May 15, 1900. A similar call for bids was advertised to be opened on June 1, 1900, for a bridge at Division Street over the North Branch Canal.

The specifications were drawn very broad for the purpose of giving competitors as wide a scope as possible in their designs and selection of a new type of bridge. The only restrictions in regard to type were in both cases:

"The bridge shall be a movable structure without centre pier and shall leave a channel with a clear opening of 120-ft. at 95th Street and 80-ft. at Division Street. The bridge shall have two roadways 18-ft. in the clear, or one roadway 38-ft. in the clear between the wheel guards and two side-walks 8-ft. in the clear, and shall have an overhead clearance of 16-ft. There must be an underbridge clearance of 16½-ft. above Chicago Datum for a space of at least 40-ft. at right angles to the centre of the channel. The general appearance of the bridge shall be as graceful and attractive as the nature of the structure will permit."

Five designs were submitted by outside bidders, some of these bidders having two or more alternate designs differing in matters of detail. With one exception, the designs were for bridges revolving on fixed bearings.[2] The contract was awarded to a bidder following one of the city's designs.

Contracts for both 95th Street and Division Street bridges were awarded so that work was started in July, 1900. Meanwhile the city's design No. 3 was modified and arranged for a bridge at Clybourn Place (later Cortland Street) over the North Branch and contracts were awarded in the late fall. These plans embodied many of the alterations suggested by the Board of Consulting Engineers, especially, the use of a full tail pit instead of separate wells for each truss. Due to construction difficulties at both 95th Street and Division Street, the Clybourn Place bridge (Fig. 5) was completed first and opened to traffic on May 24, 1902; the 95th Street bridge was not opened to traffic until April 1, 1903; and the Division Street bridge on February 1, 1903. In the construction of the 95th Street and Division Street bridges, the bottom of the abutment was lowered to the elevation of the river piers but the separate pockets for the counterweight ends of the trusses were retained. These were made of sheet steel covered on the outside with concrete and have been a frequent cause of repairs. The machinery was set on structural supports, and it has been difficult to maintain alignment. Changes were also made within a year after completion of the bridges, in the braking system to make it more effective. Fig. 6 shows the Division Street bridge.

[2] "Engineering News," January 10th, 1901.

One of the earlier types of bridges was eliminated from further consideration when the Canal Street jackknife bridge was replaced by a Scherzer bridge in 1903, and the Weed Street bridge was finally removed in 1905 after having been out of service for several years. However, in 1903 a new type appeared with the completion of a Page bascule bridge at South Ashland Avenue.

In 1904 a new method of financing the construction of bridges was devised when the State Supreme Court ruled in favour of a bond issue for this purpose.

By the end of 1904 the city had five bridges of its design in use with further improvements in the last two, one at Division Street (Fig. 7) and one at North Western Avenue, both over the North Branch. In both of the two later bridges, instead of using shaped iron castings bolted to the trusses for counterweight as was done in the first three bridges, a structural box was framed between the tail ends of the trusses. These tail ends were sloped downward back of the trunnions, whose supports were changed to tapering box girders sloping upward at the back so as to pass over the counterweight box. The box was filled with the counterweights consisting of about 22% shaped castings and the remainder a mixture of pig iron, punchings, and cement grout to produce a material weighing about 375-lb. per cu. ft. The bottom of this box was floored with a grillage of old rails to carry the weight of the extremely heavy counterweight material to the main girders. There were many advantages in this type of construction. First, it allowed the centre of gravity of the counterweight to be placed farther back from the trunnion, thus saving material. Second, it eliminated the necessity for the specially shaped castings with their greater unit cost. Third, the counterweight material did not have to be bolted piece by piece to the trusses with the danger, later, of dropping if bolts rusted away.

Four of these bridges were on pile foundations, but, at North Western Avenue bridge, piles could not be driven below—22-ft. Chicago Datum because of a very hard indurated clay, which could safely sustain a load of 4,000-lb. per sq. ft. Accordingly, piles were omitted and the masonry rested directly on the soil. This bridge also had the tail pits especially waterproofed with a 4-in. layer of Portland cement mortar on both the inside and outside walls below water level. A distinct improvement in the machinery consisted of taking the motors from the two gear trains and combining them in a unit in back of the centre trusses. Two sets of hand brakes were operated by hand levers in the operator's room. Also the pneumatic buffers at each end of the travel were eliminated and wooden bumper blocks were placed on the under side of the trunnion girder with which the top of the counterweight box came into contact in the closed position to limit the final position of the leaf. The decelerating speed of the trusses was entirely controlled by the machinery brakes. It had been found that the pneumatic buffers were too slow in operating and the pressure relief valves were too temperamental.

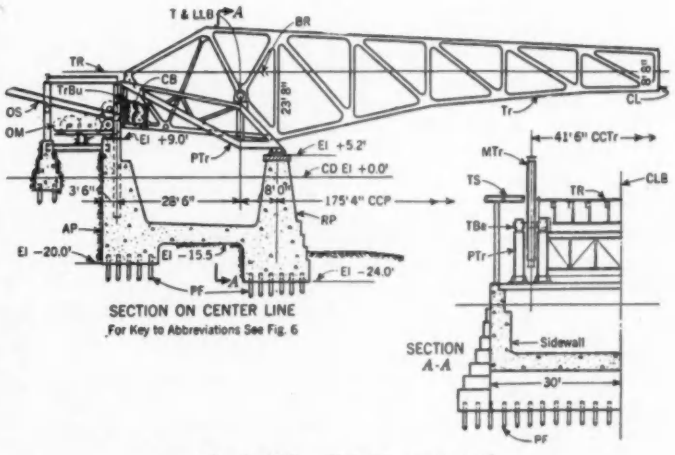


Fig. 9. West Erie Street (1910).

Movable Bridges across Port Waterways—continued

In 1903 plans were prepared for a double-leaf trunnion bascule bridge at Archer Avenue, over the South Fork of the South Branch, but later the federal government issued a revised permit with the clear channel reduced from 136-ft. 8-in. to 107-ft. Investigation showed that a one-arm structure would be feasible, especially if the type of machinery worked out for North Western Avenue were adopted. By increasing the radius of the pin rack from 30-ft. used in the North Western Avenue bridge, to 36-ft. it was found that the machinery would have to be only a little heavier. The leaf was placed on the west side of the river with the idea that the prevailing west or southwest winds of the navigating season would assist rather than hinder the closing of the leaf. The trunnion supports were again changed, this time to an inverted triangular truss with the apex under the trunnion. This was necessary as the load was rather large for the tapered box girder type used at North Western Avenue. The bumper for the bridge, when down, was attached to the under side of this truss and, in addition, a bumper for the bridge in the open position consisted of a rubber block 7-in. by 8-in. section attached to the top of a bracket on the fixed part of the steel, placed so that a bumper bracket on the top chord of the trusses came into contact with it when the leaf reached the fully open position. This type of bridge proved more economical than a double leaf. The only disadvantage was the open street on one end. At this end a counterweighted barrier was installed that raised above the roadway level when the bridge leaf was raised.

In 1909 a single-leaf bridge was built at West Kinzie Street (Fig. 8) over the North Branch that was almost identical with the Archer Avenue bridge, previously described, with some improvements in the barrier. Two more double-leaf bridges were built, one at North Avenue over the North Branch and the other at North Halsted Street over the North Branch Canal. These showed only minor variations from previous practice.

In 1910 a double-leaf bridge was built at West Erie Street (Fig. 9) over the North Branch that was radically different from previous practice. The grade of the roadway is about 6-ft. higher than on the previous bridges; hence it was feasible to approximate the outline of an arch. Two trusses were used instead of three, as previously, without overhead bracing. They extend only about 10-ft. above the roadway at the rear ends. Due to reduction in depth of the tail end, the rear external pin rack was no longer usable, so the bridge was operated with operating struts. These struts were connected to pins cantilevered out sideways from the bottom chords just ahead of the counterweight box. The machinery gear trains were placed in the rear of the bridge, as before, but at the sides just back of the trusses with the main pinions engaging racks on the struts held in contact therewith by guide rollers. Each train is assembled complete, including motors, in one unit and mounted upon a unit frame to keep parts in permanent alignment. Similar to earlier bridges, the trunnion supports consists of trusses, with the difference that the truss shape now is quadrilateral rather than an inverted triangle. This change was made to accommodate the heavier loads, this bridge having only four supports per leaf rather than six as with the three truss bridges.

(To be continued)

Legal Notes

Harbour Authority and Care of Moorings

A case bearing on the responsibility of a harbour authority for the maintenance in good condition of the moorings provided for craft in the harbour was heard during July at the Admiralty Court before Mr. Justice Bucknill, sitting with Captain W. E. Crumplin, Elder Brother of Trinity House.

The owner of the auxiliary yacht, *Quercus*, claimed damages from the Mayor and Corporation of Torquay, who own the moorings in Torquay Harbour, for the loss of his yacht by reason of the parting of her moorings in a gale on the night of November 9th-10th, 1941. The harbour authority denied defect in the chain or swivel, and said, alternatively, that if there were a defect it was due to abnormal shocks the plaintiff imparted to it, or if there were latent defects in a link, the parting could not have been avoided by any care on the part of the harbour authority.

In delivering judgment, Mr. Justice Bucknill said the mooring chain was ⅞-in. in diameter, and was put down as new galvanised in May, 1940. From the upper end, 11½-ft., was a swivel to prevent the mooring chain from kinking when the yacht swung, which she would not do to the tide, but only under pressure of wind. The Elder Brother who advised the Court, having examined the chain, said it was an efficient mooring chain for the *Quercus*, but had nothing to spare in strength; it required careful attention and maintenance if it was to continue efficient.

The Court, however, thought that the maintenance of the chain had not been adequate. The Elder Brother said that if the chain were examined annually, the end should be unshackled and brought up, washed and the chain carefully examined link by link, and the swivel should be examined and cleared of rust and marine growth. The burden was on the defendants to show no negligence, and maintenance by suitable examination, which his Lordship thought they had not done, and judgment must be for the plaintiff with costs.

Claim for Attendance Money

In the Mayor's and City of London Court a case was heard on July 29th in which a lighterman (Ernest Richard Lefever) claimed 18s. in respect of attendance money for three " calls " under the Dock Labour Scheme for the Port of London, arising out of the Essential Work (Dock Labour) Order, 1941. Lefever claimed that he was entitled to decline to " carry out orders which had nothing to do with the lighterage trade." In giving evidence, he admitted that the Dock Labour Scheme applied to him. In view of his refusal to do porterage in company with three corn porters his card was stamped " Refused employment."

Giving judgment against the claimant, Judge Thomas said: " This work which he was to do was carrying corn in conjunction with three piece-workers. He took the view that he was not bound to do that work, because, some time ago, he says, there had been a dispute, and as a result of that the lightermen were not called upon to work piece-work with the corn porters. Apparently, in fact, some of them have been doing it.

" I think the real trouble here is that there were four men working and one of them does not earn so much as the others—which one can quite understand is not very acceptable to the lighterman. That matter is still in negotiation, and I hope will shortly be settled to the satisfaction of all parties, but I am not concerned with that.

" All I am concerned with here is whether the plaintiff is entitled to this call money under the terms of the Scheme—because it is under the Scheme that he was working. He knew that he was working under the Scheme, and he knew that the Scheme laid down the terms upon which he had got to work. Unfortunately, he was not able to obtain a copy of the Scheme. He says he tried, and it was only quite recently that he got a copy.

" Now, under the terms of the Scheme, by Clause 15, ' A port transport worker, other than a weekly worker, shall carry out the instructions of the Port Manager, and, in particular, shall . . . proceed to and accept any employment for which he is suitable to which he is directed by the Port Manager in connection with port transport work. . . .'

" The only question, I think, which I have got to decide is whether he was suitable for the work, because it is not disputed that he was directed to proceed to and accept employment. That employment was corn backing, and the question is whether he was suitable. So far as that is concerned, on the plaintiff's evidence, I can only hold that he was suitable. Not only does he say, ' I could do the work,' but he says, ' I could have done the whole of this by myself, if I had been asked to.' I do not see how, in face of that, I can say that he was not suitable for the work. As he refuses to do the work, he has not complied with the terms of the Scheme—and he was not able to get his card stamped with an ' attendance stamp.'

" The result is that he cannot recover the amount of those calls, and there must be judgment for the defendants."